

SELF-GUIDED TOUR



Grade 7

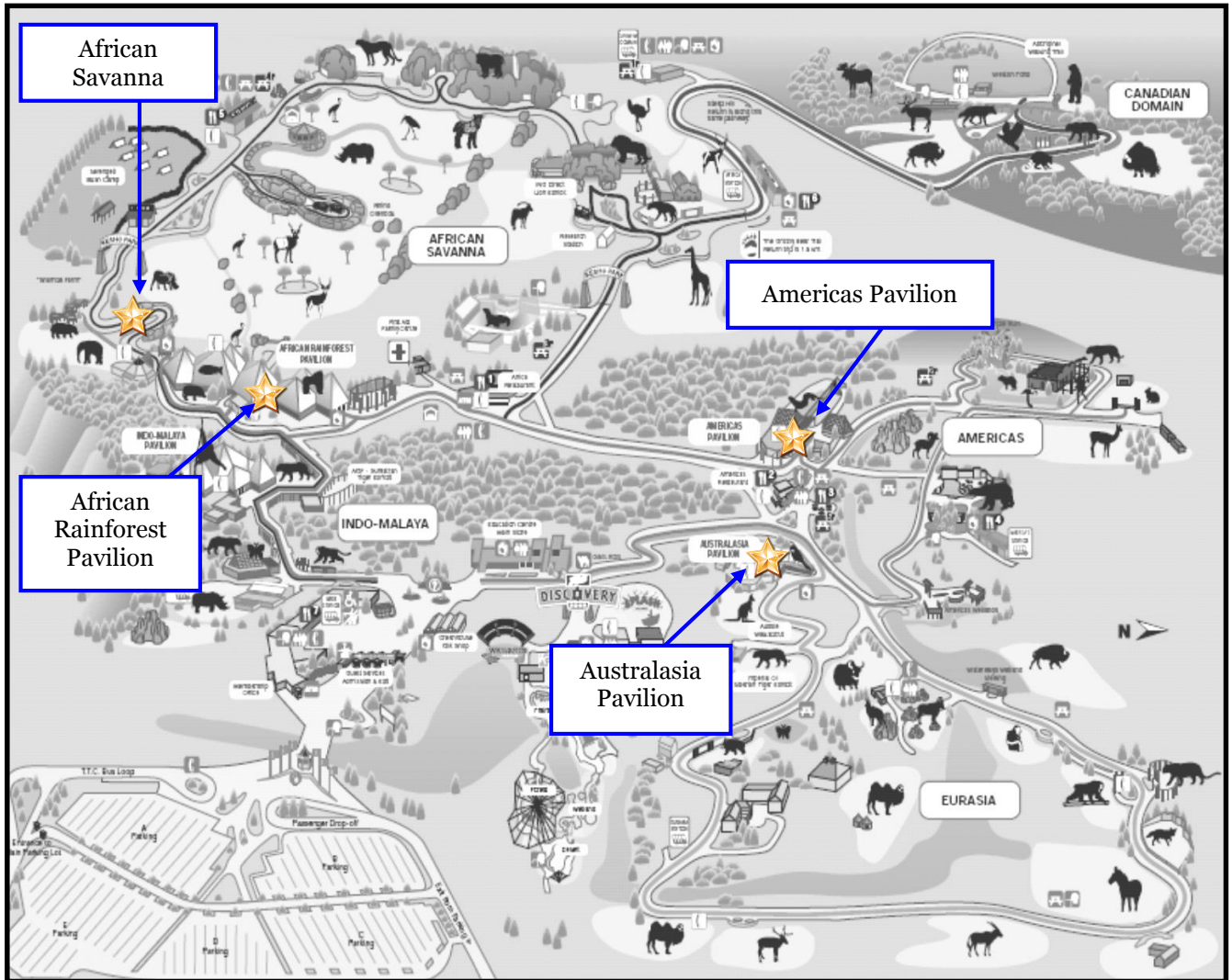
Interactions within
Ecosystems

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Site Map

★ = Stops on your tour



Grade 7 Curriculum Objectives:

- Assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts.
- Investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem.
- Demonstrate an understanding of interactions between and among biotic and abiotic elements in the environment.

INTRODUCTION

The following discussion outlines suggested topics for review prior to visit.

Ecosystems

- At the Toronto Zoo you will encounter a variety of ecosystems which refers to the organisms living in a particular environment, such as a lake or forest, and the biotic and abiotic parts of the environment that affect them.
- *Biotic* factors refer to all living components in the environment, including plants, animals, and microorganisms. *Abiotic* factors refer to all nonliving components in the environment including sunlight, temperature, water, elements, and minerals. Look around your environment, what are some biotic and abiotic components present?
- All of the biotic factors are contained within the *biosphere*, this refers to the realm of the Earth in which life exists. The biosphere begins in the lower atmosphere and ranges to the ocean floor.
- A *biome* refers to a large geographical area with a characteristic climate, flora and fauna. There are multiple biomes found on the planet, some of which overlap with each other.
- Most authorities only recognize about 15 terrestrial biomes for the entire earth:
 1. Tundra (treeless, sometimes marshy plains; northern Asia & North America)
 2. Northern coniferous forest (a.k.a. boreal, or taiga)
 3. Temperate coniferous forest
 4. Temperate broadleaf forest (oak - hickory forests of eastern USA)
 5. Temperate grassland (prairies of North America)
 6. Desert and dry shrub (Sahara)
 7. Mediterranean shrub
 8. Mountain grassland
 9. Flooded grassland and savanna (Florida Everglades)
 10. Tropical grassland and savanna (African savanna)
 11. Tropical dry forest
 12. Tropical coniferous forest
 13. Tropical moist broadleaf
 14. Mangrove
 15. Permanent ice covers (Antarctica, parts of Greenland)
- During your visit to the Zoo, you will encounter many biomes and the plant and animal species that reside in these ecosystems. Take notice of the different characteristics that

both plants and animals possess in specific biomes and how multiple species form a community.

- *Community* refers to all animals, plants and microorganisms that live together in a particular habitat/ecosystem and affect one another as part of a food chain, or through their various influences on the physical environment. Species that reside in the same habitat generally rely on each other, if one species is affected negatively by an outside factor, the other species within the habitat will also be inadvertently affected (keep in mind this effect could be positive, negative or no effect at all).
- Within ecosystems there are certain species known as *keystone species* that play a very important role which provide necessary conditions for several other species. An ecosystem is dependent on this organism and the removal of the organism will lead to either the collapse or drastic changes in the environment.

Trophic Levels

- An example of the dependence between organisms is illustrated by a food chain. Think of a food chain as a ladder, which begins with producers and then is followed with rungs of different animals which are known as consumers. Each step on the ladder is known as a *trophic level* and is used to track the transfer of energy and nourishment amongst the organisms in the ecosystem.
 - The rule of 10% states that as you move up through trophic levels only 10% of the energy is transferred to the consumer. This is due to energy being used for metabolic processes, locomotion, heat production, reproduction, etc. This causes predators at higher trophic levels to consume more food to make up for this lost energy.
 - At the end of the food chain are decomposers, which break down dead organic matter and function in returning nutrients to the environment, thereby, completing the circle of life!
 - The first trophic level contains producers which are plants that convert light energy into organic energy (sugars). The next level is the primary consumer (1^o consumer) which consists of herbivores and omnivores that consume the producers (plants). The following list illustrates the ongoing food chain with subsequent trophic levels.
 - Producer - Vegetation
 - 1^o Consumer – Organisms eating producers
 - 2^o Consumer – Organisms eating 1^o consumer
 - 3^o Consumer – Organisms eating 2^o consumer
 - 4^o Consumer – Organisms eating 3^o consumer
 - Decomposer – Eats all levels when dead.
 - This food chain displays the interconnection between all organisms in an ecosystem. If one link in the chain is broken, all other links become strained. Think about a situation where a top predator such as a wolf is removed from an ecosystem. This will lead to overpopulation of herbivores and the destruction of producers. As a result, the herbivore population will start to decline due to the reduction of food resources. Thus all organisms in an ecosystem are vital to the survival of that ecosystem!

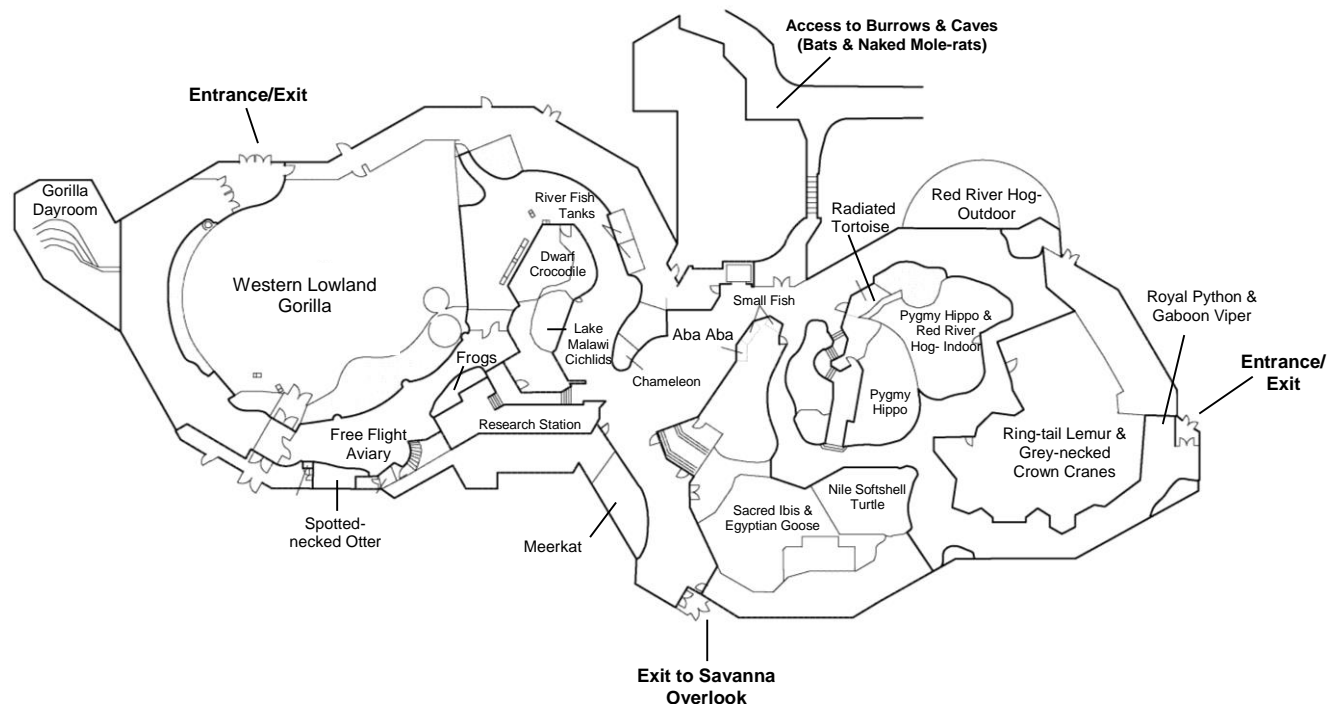
Species Interactions

- Within an ecosystem species interact with each other and maintain relationships including animal-animal, animal-plant, and plant-plant. Symbiosis is defined as an interaction between two species living in close proximity to each other which lasts over time. There are several types of relationships that can exist between organisms. These include the following:

- *Mutualism* is when both organisms within a relationship benefit from each other. For example hermit crabs can carry around anemones on their backs for protection and this provides the anemone with a wider variety of food. “Good for me, good for you”.
- *Commensalism* means that one organism is benefitting from the relationship and the other organism is not affected. For example, red-bellied turtles incubate their eggs in old alligator nests. This is extremely beneficial for the turtles however the alligators are no longer using the nests, thus they maintain a neutral position in this relationship. “Good for me, does not bother you”.
- *Parasitic* means that one organism is benefitting from the relationship whereas the other organism is negatively affected. An example is fleas living amongst the fur of dogs. This environment is perfect for the flea because they have ample food and protection; however, the dog suffers from this relationship. “Good for me, bad for you”.
- *Competitive* means that both species are negatively affected by the relationship. An example is when lions and hyenas are competing for food resources. “Bad for me, bad for you”.
- *Neutral* means that both organisms are unaffected by their relationship with each other. For example some fishes that reside around coral reefs have neutral relationships meaning they are not competing for resources but they are also not gaining benefits from each other, they are just coexisting in the same area. “Does not bother me, does not bother you”.

TOUR

African Rainforest Pavilion



Western lowland gorilla

- Western lowland gorillas inhabit the *tropical moist broadleaf* biome of Central Africa. These animals are herbivorous (*primary consumers*) and feed mostly on vegetation and fruits that are found low to the ground.
- Gorillas are diurnal animals meaning they sleep during the night and they actually build nests for sleeping. Small gorillas can build nests in low level trees but bigger males usually build on the ground due to their size.
- As mainly fruit eaters, gorillas play an important role in seed dispersal; this is an example of *mutualism* because both species are benefitting from their interactions.
- Gorillas are rarely predated, however humans hunt them for the illegal *bush meat trade* and mining in the Democratic Republic of Congo for Coltan (used in cell phones) leads to indiscriminate killing of these animals. Within the Congo, the U.N. Environment Program has reported that the number of eastern lowland gorillas in eight national parks has declined by 90% over the past 5 years.
- The Toronto Zoo participates in the PhoneApes program where visitors can donate their old cell phones for recycling of the Coltan metal ore.



<http://www.torontozoo.com/conservation/PhoneApes.asp>

West African dwarf crocodile

- These animals inhabit mostly *tropical moist broadleaf* but may sometimes live in *savanna* regions close to the rain forest. These crocodiles hunt mostly in the water, feeding on small fishes and frogs.
- The dwarf crocodiles are found at a higher *trophic level* compared to gorillas. This is because the gorillas feed on vegetation (*primary consumers*) and the crocodile feeds on other animals (generally *tertiary consumers*).
- Dwarf crocodiles are currently listed as vulnerable on the IUCN red list. These animals are hunted for *bush meat* as well as their skins (although the leather is of poor quality), and *deforestation* due to the ever increasing human population is also affecting their habitat.
- These animals are nocturnal and possess a third transparent eyelid which protects against *abiotic* pressures such as water while hunting for its prey. They also have a special respiratory system that allows them to eat while submerged without breathing water into their lungs.

African lungfish (River Fish Tanks)

- This freshwater fish inhabits stagnant and low laying muddy waters found in the *tropical grassland and savanna* biome. These animals are generally *secondary consumers* and feed on bottom fishes. The young lungfish feed on worms, larvae and crustaceans.
- In this biome there is a prominent dry season which leads to drought in large bodies of water. During this season, how do you think the African lungfish can survive? (Hint: think of the name of the species) African lungfish possess primitive lungs and breathe air every 30-60 minutes.

- These animals also breathe air through their reduced gills. When the lake dries up these animals bury themselves in mud and secrete a mucous which congeals to form a cocoon around them. A small opening is left at the mouth so they can breathe air.
- These animals are a dark grey-brown mottled colour on their dorsal side and a paler brown on their ventral side. How do you think this colouration is useful in the animal's habitat? This colouration provides camouflage for the lungfish both in the muddy waters during the rainy season and when buried in the mud during the dry season.



Red river hog

- These omnivorous ungulates (hoofed animals) inhabit various biomes such as *tropical grassland and savanna* as well as *mangrove swamps*. They feed on mostly vegetation but are known to also eat birds and domesticated livestock. These animals are generally *primary consumers*.
- Looking at the red river hog, what animal does it resemble? A pig! The red river hog is sometimes known as a bush pig and is a wild member of the pig family.
- Red river hogs rest in burrows during the day and are more active at night. This allows them to be concealed from their main predators, the lions and hyenas.
- These animals live in a *community* with 4-20 members, which usually consist of a dominant male, several females, and piglets. Living in large herds can assist the animals in protection of young and standing off against predators such as the leopard.

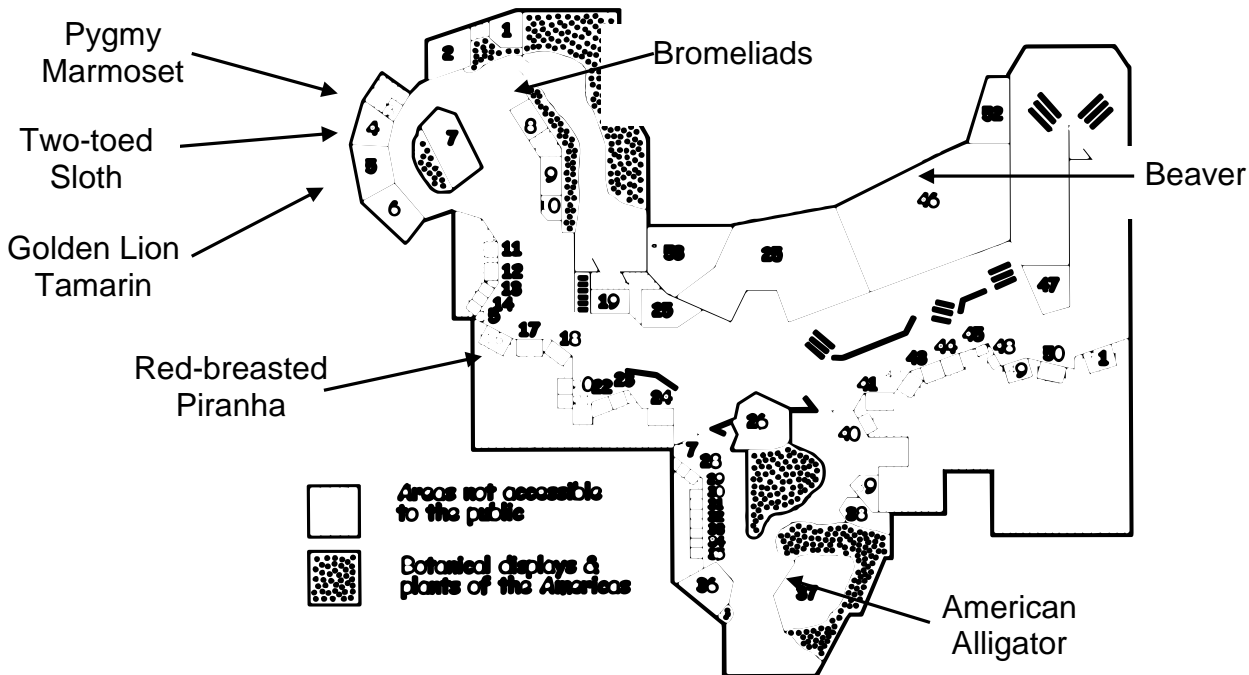


African Savanna

River hippopotamus

- These animals inhabit the *tropical grassland and savanna* biome of Africa, and as *primary consumers* feed mostly on dry and tough grass as well as some fallen fruits.
- Adaptations to the *abiotic* pressures of temperature and sunlight exposure are to spend most of their time submerged in water. While in the sun they can secrete an oily red fluid which protects their skin from sunburn and appears like the animal is sweating blood!
- Where do you think hippos sleep? Hippos actually sleep underwater and rise to the surface for air automatically. When the temperatures cool at night hippos leave the water and graze for 7-8 hours.
- Hippos live in herds of up to 30 individuals, and their huge canine teeth made of ivory are their principal weapon.
- Hippos play an integral role in the ecology of inland waters, by maintaining bank-side vegetation and excreting large amounts of feces into the water. The nutrient rich feces encourage the growth of plankton and invertebrates which in turn act as food for fishes, thereby sustaining the entire ecosystem.
- Water birds such as the Cattle Egret maintain a *mutualistic* relationship with hippos, by residing on the backs of the hippos the birds act as housekeepers in the removal of irritating insects and receive protection as well as a source of food.

Americas Pavilion



Bromeliads

- These are specialized plants that do not need to put down roots in the soil and can grow on many trees within the *tropical moist broadleaf* biome of the Americas. These plants actually have “water tanks” that are formed by overlapping leaves at the base of the plant. These leaves act as a receptacle to catch and store rainwater.
- Bromeliads are very useful additions to an ecosystem as many animals benefit from their presence. Some monkeys drink from the water tank of the bromeliad and thus rarely need to return to ground. Several amphibians use these plants as a nursery by depositing their eggs in the water tank where the larvae can then develop in a safe habitat.
- At what trophic level would you expect to find these plants? Some bromeliads are actually carnivorous and feed on insects, making them *secondary consumers*!
- Bromeliads can have a *parasitic relationship* with the trees they grow on; the weight of these plants can lead to loss of tree branches or the collapse of the entire tree!

Pygmy marmoset

- These omnivorous animals are generally known as *primary consumers* considering the main component of their diet consists of gum from trees. Can anyone guess what tree gum is? Sap!
- These small monkeys are found mainly in the understory which is located below the canopy (<30 metres) in the *tropical moist broadleaf* and *tropical coniferous forest* biomes in South America.
- The main predators of these monkeys are birds of prey; marmosets reside in the understory where the above vegetation is thick enough to avoid predation by raptors.

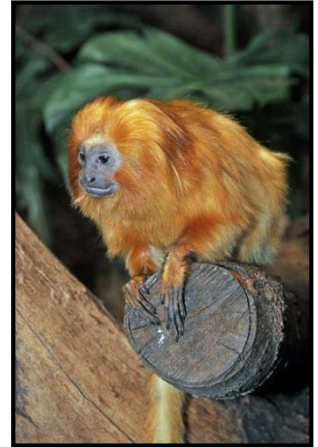


Marmosets rely on good visibility within their living range to be aware of the presence of predators and food sources.

- Marmosets have effective methods of communication including high sharp warning whistles and clicking sounds used to warn others in the presence of danger!
- These monkeys have monogamous relationships, which means that one male and one female mate for life, they also reside with other family members and together establish feeding territories which exclude other pygmy marmosets.

Golden lion tamarin

- These omnivorous monkeys reside in the lower portion of the understory in the *tropical moist broadleaf* biome of South America where they feed on insects, snails, small lizards, fruits, small birds, and eggs.
- The diet of these animals ranges widely and thus the trophic levels that these animals occupy also range from *primary consumers* to *secondary consumers*.
- Tamarins share a *mutualistic relationship* with trees, the tree provides them with food (fruits) and the tamarins remove insects as well as disperse the seeds of the tree.
- A *parasitic relationship* occurs between tamarins and fleas, ticks, mites and some internal parasites. These parasites reside in or on the tamarins and can induce sickness in these animals.
- These animals are critically endangered mammals due to habitat loss, the illegal pet trade, experimental laboratory use, and zoo collections. However, the Toronto Zoo is currently involved in a breeding program to help increase the golden lion tamarin population and organizations are currently working on reintroducing this species to the wild.



Two-toed sloth



- This animal is a folivore meaning it can survive on leaves alone, but can also eat fruits when available. The sloth lives in the canopy of the *tropical moist broadleaf* biome in South and Central America.
- During the day the sloth hangs motionless and upside down from branches in the canopy. The thick, long, grey-brown coat provides camouflage from *biotic* pressures such as predation by jaguars, ocelots, birds of prey, and snakes.
- The sloths have a type of single celled algae that resides in the hollow guard hairs of the animal, producing a greenish sheen which adds further camouflage to the sloth amongst the foliage. Other insects benefit from this mutualistic relationship (between the sloth and algae) by feeding on the algae and living within the fur of the sloth. The insects gain protection and food from these animals, illustrating how the sloths are a significant component to the ecosystem.

- Think about how many times you need to go to the bathroom a day. Now take a guess at how often sloths go to the bathroom? Since sloths eat mainly tough vegetation their digestive mechanisms are very slow, resulting in the sloth defecating approximately once a week. They also urinate infrequently because they do not drink water; they only obtain liquids from dew and their vegetation diet.

Red-breasted piranha

- This omnivorous fish resides in freshwater lakes and streams in South America. These animals are *secondary consumers* but are known to consume fruits and seeds when they inhabit flooded forests during the wet season.
- Piranhas have a slender muscular tail which functions in propulsion through the water towards their prey. They also have especially thick scales in the area of its head which serves in protection as the fish bumps up against its prey when feeding.
- Piranhas play an important role in South American ecology because they prey upon diseased and injured animals, although they are probably vulnerable to disease from parasites. Piranhas serve as a barrier for diseased animals that would otherwise become an epidemic.
- These animals can smell blood from long distances with their elaborate external nostrils and will react in a frenzy to search out the source of the blood. So if you are bleeding don't go into the freshwaters of South America, especially since piranhas actively seek out human blood!
- If no food sources are available piranhas will engage in cannibalism which means they will actually start devouring each other!

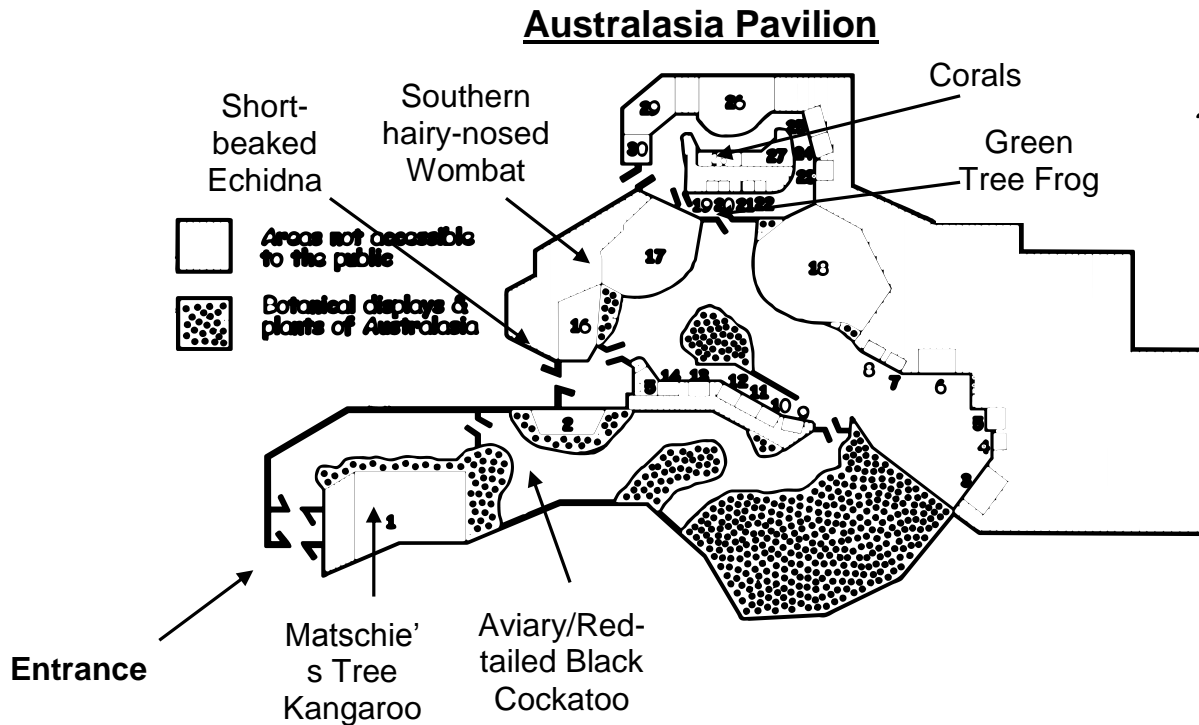
American alligators

- This carnivorous animal inhabits the *mangrove* biome, as well as rivers and ponds in North America. These animals are *tertiary consumers* that feed on rodents, fish and other reptiles.
- The American alligator is considered to be a *keystone species* which means that it has a very important role in the environment. These animals help control prey populations and also create habitats which are necessary for the survival of other species. For example, red-bellied turtles incubate their eggs in old alligator nests.
- Alligators are nocturnal and frequently hunt underwater, what type of *adaptation* do you think would be necessary for this activity to be successful? Consider what you would use to see underwater? Alligators possess a third eyelid which is a clear membrane that covers their eye and allows them to see underwater, this can be compared to goggles!
- Another adaptation that aids in hunting is the location of the eyes and nostrils on the upper portion of their head. This allows alligators to perform "sneak attacks" by remaining almost completely submerged in the water while waiting for unknowing prey to approach the water.
- Alligators are reptiles and are "cold-blooded" meaning they cannot internally regulate their body temperature like most of the animals we have already observed today. When alligators are affected by the *abiotic* factor of low temperature their body activities slow down. The alligators become sluggish, stop eating, and eventually become dormant. During this period alligators are able to live off of fat reserves stored in their tail.

Beaver

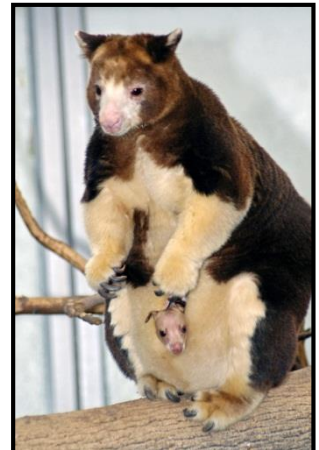
- This herbivorous mammal inhabits *temperate broadleaf forest* and *temperate coniferous forest* biomes of North America and creates large dams in which to live in ponds, rivers and streams. Look inside the beaver lodge/dam, what purposes do you think it serves? The lodge functions as a home for the beavers providing protection during sleep and the raising of offspring.
- Some other functions of the beaver dam are to create habitats for various other species, maintaining and controlling the water level, and preventing flooding and erosion. All of these factors contribute to the beaver being a *keystone species*, similar to the alligator we saw earlier. The beaver shares a *commensalistic* relationship with animals such as the moose, waterfowl, woodcocks, and white-tailed deer because these animals benefit from the presence of the beaver whereas the beaver could care less!
- Beavers feed on a variety of trees including aspen, birch, and poplar.
- Considering beavers spend much of their time in the water, can you think of any adaptations that would be beneficial to these animals (Hint: remember the alligator)? Beavers possess valves within their ears and nose that prevent water from entering these openings. They also have a clear membrane which covers their eyes and protects them from the aquatic environment.
- Threats to these animals consist of destruction of their habitat, water pollution, loss of food resources due to deforestation, and predation by large mammals such as wolves, foxes, bears, otters, and lynx.





Matschie's tree kangaroo

- This herbivorous mammal is found within the *tropical moist broadleaf* biome of Papua- New Guinea and resides in the upper and middle layers of the canopy in small groups, where they sleep and feed in safety. These animals are known to forage on the forest floor as well as in the trees where they feed mainly on leaves and fruits. This makes them *primary consumers*.
- This animal is a specialized type of mammal known as a marsupial. Does anyone know what is special about marsupials? Marsupials are mammals that raise their young in a pouch located on their abdomen. Can you give an example of another type of animal that is also a marsupial? Wallabies, koala bears, wombats, and opossums.
- Benefits of the pouch include protection for the young marsupial and the location of nursing. The animal can continue to enter the pouch to nurse until it can feed on its own or the mother says it is time to move out!
- These animals have large clawed nails that are useful in climbing and also rely on their long tail to aid in balance.
- These animals are threatened and are hunted for their flesh by man.



Aviary / Red-tailed black cockatoo

- As we enter the pavilion, look around at the variety of plants within the aviary. These are representative of rain forest areas in Australasia which are home to a large number of the countries' wildlife.
- Although Australia is known for its outback regions, the small rain forest region is home to over half of the continent's butterflies, birds, and ferns, and a third of the mammal species.

- See if you can spot the red-tailed black cockatoo within this aviary. This bird is black in colour with a large crest on its head. These birds are found in *tropical moist broadleaf* biome in Australasian regions.
- These birds are generally *primary consumers* and feed on various seeds, fruits, some vegetation, and the larvae of insects.
- Cockatoos are usually found in groups ranging from 2-12 individuals where there is no apparent pecking order. This allows these animals to coexist peacefully when mass feeding and perching at night.
- Another species known as the sulphur crested cockatoo, communicate effective warning calls which benefit all cockatoos and other animals in the area.



Short-beaked echidna

- This omnivorous animal inhabits the *tropical grassland* and *tropical dry forest* biomes in Australasia and feeds on various insects that it grasps with its worm-like sticky tongue. What type of consumer is this animal? A *secondary consumer*.
- This animal is another specialized type of mammal found within Australia. Echidnas are monotremes; this means that they are mammals who lay eggs! A female echidna lays 1 or 2 eggs and deposits them into her pouch. Inside, the eggs will hatch and the offspring will remain within the pouch until they begin to grow spines – ouch!
- Can anyone spot the echidna? The echidna is a nocturnal animal which means they are active during the night. If you cannot see the echidna it is probably sleeping behind a log in the exhibit.
- Echidnas can regulate their body temperature to some extent, but in response to *abiotic* pressures such as low temperatures, echidnas go into a state of hibernation. Hibernation usually lasts for 10 days and during this time the body processes of the echidna slow down.
- As you have seen with the Matschie's tree kangaroo and the echidna, Australia has some very unique mammals! This is because Australia is an isolated continent surrounded by ocean and the animals cannot travel to or from the continent. These interesting animals can only be found in Zoos outside of Australia.

Southern hairy-nosed wombat

- This herbivorous animal inhabits the *temperate grassland and savanna* biome of Australia. Wombats are *primary consumers* and feed on grasses, bark, roots, and fungi. They reside in burrows also known as “warrens” which can be up to 100 metres long and have up to 23 different entrances!
- Wombats are nocturnal animals that live in communal societies ranging from 5-10 individuals. Unlike some other animals groups such as gorillas where females stay and males move on, wombat females actually travel to different warrens whereas males remain in their home warren.
- Wombats play a significant role in maintaining their ecosystem acting as “gardeners of the desert”. These animals crop plants and maintain grasses at early growth stages thereby

providing food for themselves as well as kangaroos and domestic livestock. Furthermore wombats enrich the soil with their droppings and frequently dig, turning the soil.

- Similar to the Matschie's tree kangaroo we saw earlier, wombats are also marsupials who deposit their young into the pouch at an early developmental stage.

Green tree frog

- These amphibians inhabit cavities in the coolibah tree found in the *tropical dry forest* biome, but also have a *commensalistic* relationship with man and frequently can be found in bathrooms, toilets, water tanks, troughs, windmills, and downpipes. In this way the frog benefits from the presence of humans whereas we are not bothered by the frog.
- These animals feed on insects and invertebrates and can be considered *secondary consumers*.
- Look at the discs on the end of the green tree frogs' fingers and toes, what do you think these are used for? The discs increase the surface area of contact and aids in climbing.
- These frogs only breed during times of heavy rain. At the Zoo these animals need to be moved into water tanks in order to initiate breeding.
- This species is mainly nocturnal, however during the mating season they become diurnal.

Coral reef

- Coral reefs represent a tiny proportion of the world's ocean waters, and yet they are a marine ecosystem consisting of nearly a quarter of all marine species. The microorganisms that live on the reef provide food for the corals as well as the beautiful colours that you can observe.
- The Great Barrier Reef off the coast of Australia is a *community* of over 400 species of corals, and is the largest coral reef on the planet. Do you think corals are plants or animals? Corals are animals that secrete an exoskeleton which forms the solid part of the reef that you are looking at in this exhibit. These animals are *primary consumers* and feed on microorganisms.
- The Great Barrier Reef is currently endangered due to the sensitivity of the reef organisms. Both *abiotic* and *biotic* threats are currently affecting the reef including water pollution, and human activities such as scuba diving, and fishing boats.
- Specific regions of the Great Barrier Reef are protected and prohibit threatening activities. Destruction of this ecosystem will result in the extinction of a wide variety of tropical animals and will greatly decrease the biodiversity of the planet. This could mean no more Nemo!



CONCLUSION

Sample Discussion Questions

- What are some examples of biomes that we observed today? Compare that to where you live and note any similarities or differences to any one of the biomes.
 - Freshwater aquatic, marine aquatic, tropical moist broadleaf, tropical dry forest, tropical grassland and savanna, tropical coniferous forest, temperate broadleaf forest, temperate coniferous forest, mangrove, and temperate grasslands.
- Consider all of the interactions between species that we observed today. Think about your own life and how you interact with different species on a daily basis. Can you name any of these relationships using these terms: mutualistic, commensalistic, parasitic, neutral, and competitive?
 - Students can point out their interactions with their pets which can be viewed as a mutualistic relationship, where the student benefits companionship, love, and in some cases protection whereas the pet receives food, shelter, and protection.
 - An example of a parasitic relationship could be between students and lice! The lice benefit with a home and food whereas the students are itchy with irritated scalps and are shunned from social interactions until the lice have been removed.
- Think of how we interact with our environment today, what are some ways in which we can improve this relationship so that both humans and the environment can benefit.
 - Examples include participating in Earth Day, Earth Hour, composting, twenty-minute makeover, tree-planting, recycling, using biodegradable products, reusable containers, reduce plastic products, reducing bottled water usage, reducing emissions, etc.
- Try classifying the following animals in terms of trophic levels: West African Dwarf Crocodile, Red-breasted Piranha, and Western lowland Gorilla.
 - West African Dwarf Crocodile: Sunlight → Aquatic plants (producer) → Herbivorous Fish (primary consumer) → Carnivorous Fish (secondary consumer) → West African Dwarf Crocodile (tertiary consumer)
 - Red-breasted Piranha: Sunlight → Aquatic plants (producer) → Herbivorous Fish (primary consumer) → Red-breasted Piranha (secondary consumer)
 - Western lowland Gorilla: Sunlight → Plants – fruits (producer) → Western lowland Gorilla (primary consumer)