

Dragons Are Alive!

Habitat Design to Showcase Dragons

Layout of how to create a habitat within a zoo to showcase dragons safely

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Preface: Dragons

In order to best determine a design for showcasing dragons, we need to understand dragons themselves as an animal.

Physical Aspect

Dragons are warm-blooded carnivores that resemble reptiles. Most dragons will appear as similar to the images below. They will have a tail that is often longer than their bodies, a neck that is often elongated, a body with four legs, and strong wings. They are covered in scales and will typically breathe fire, though there are records of dragons that breathe frost or poisonous gas.



Figure 1 - Fire Dragon (image courtesy of Dragonika.com)

Their torso can be very round and small, like a basketball, or they can be very lean and long, like the dragons of Chinese folklore. Their size can range up to the size of a 3000' sq. ft. house, depending on their age and type. Dragons have forked tongues, sharp teeth, and claws on their feet. Most will have horns on their head or along their back and tail. And of course, dragons can fly.

One thing to note is dragons are able to communicate telepathically to humans. Humans cannot, of course, communicate back through telepathy but dragons are intelligent enough to understand human speech if they spend sufficient enough time immersed in our culture. They appear to be able to communicate to each other, to some degree, and will only communicate with humans they have frequent, close contact to. Unless they have bonded with a human since hatchling, they must be able to see the person to communicate with them. They are sentient and intelligent creatures so it is critical to treat them with care, kindness, and respect.

Fast Facts

- Height: 2' tall at birth to 40' high, assuming all four feet are on the ground
- Width (without wings): 1' wide at birth to 30' wide
- Wingspan: 4' wide at birth (tip to tip) to 170' long
- Length (head to tail): 4' long at birth to 85' long
- Weight: 15 lbs at birth to 15,000 lbs
- Flight: 50mph max, adult will fly a maximum of 200 miles without resting
- Misc Info: 4 feet with claws, horns on head and back, tough scales, usually breathes fire

Breeding

A female dragon first has instinct to breed at 100 years, and then again every century. As most dragons in the wild are often caught or killed long before their natural life cycle, this infrequent breeding period has caused dragon population to be severely limited in its ability to rebound and they are nearly extinct in the wild.

When a female dragon is ready to breed, the scales take on brighter colors to indicate readiness and the female herself is seen “peacocking” by flying around energetically in figure 8’s and roaring. She will give chase to males interested in mating, and will either choose her mate or be caught by the claws of a male if he is faster. They will lock claws together and mate during free fall from the sky, breaking off just before impact.

A female dragon will then nest in a cave for 3 months until she is ready to lay eggs. The male dragon will find and bring back food for the female to eat during this time as she does not leave the cave. Healthy female dragons can expect to lay 1-5 eggs, and after the eggs are laid, the mother may go out periodically to find her own food but will never leave the eggs for long. The eggs are laid together with piles of rocks that are heated either naturally by their bodies or by flames. The eggs will hatch in 365 days.



Figure 2 - Small dragon eggs found by a queen (image courtesy of HBO)

Dragon Lifecycle

Dragons begin their life as an egg, protected by their parents in a warm, secluded environment. Eggs are hard as a rock and can be up to 3' in height, but are typically 1-2' tall and with a smaller diameter than height. Eggs take 1 year to hatch and once hatched, the dragons will stay with their mother up to maturity. If eggs are found without a dragon, they will never hatch in the wild because they lack the heat provided by the mother dragon (an egg needs to remain at temperature above 110 degrees Fahrenheit to hatch).

A newborn dragon, called fledgling, can not yet fly and its scales are very, very soft and easy to damage. The mother dragon will tear smaller pieces of meat for the fledglings to eat until they are old enough to tear it apart themselves, about 8 years old. A dragon will have their complete set by 15 years and their scales at this time are as hard as aluminum. Their breath can only reach 4'.

At 30 years, a dragon is able to fly for a few miles and will begin hunting small prey. Their scales are hard as steel and their breath (fire/frost/gas) can reach up to 8' away.

At 60 years, a dragon is a young adult and their growth slows down from 6" a year to 1" a year. At this age they naturally leave the nest to find their own home. They have achieved their maximum distance for frost, fire, or gas at 13'.

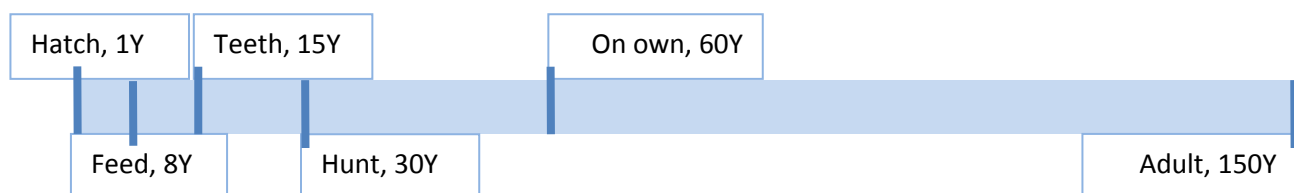
At adulthood, flames reach temperatures of 1,700 degrees F, frost is as cold as liquid nitrogen (-330 degrees F), and poisonous gas will knock a human unconscious and make them extremely ill with fever and retching upon regaining consciousness several hours later.

A dragon reaches full adulthood at 150 years and can expect to naturally live up to a thousand years. A captive dragon, however, will often only survive 500-700 years. It is thought that dragons must interact directly with nature to survive to a thousand years and more, sharing some spiritual connection humans do not yet understand.



Figure 3 - Young frost dragon, 28 YO (Image courtesy of dragonfinders.blogspot.com)

Quick Timeline



Day to Day Life

A grown dragon will live on their own until they find a mate, at which point the two will be mates for life and live together with any young dragons they have hatched. Once the young dragons have left for their own place, the male and female will continue to live together until they reach the end of their natural lifespan. If a dragon's mate dies early, their deep innate connection to one another causes enough grief that the surviving mate will stop eating and lie down to rest, next to their mate if possible.

Dragons are only found in solitary or in mated pairs, never in larger groups of mature adults. There are stories and legends that dragons will gather together into temporary communities near volcanoes once in a millennia, but no human has ever been able to ascertain the reason, and they will only remain together for a month before going their separate ways and back to their homes. Multiple mature males in a habitat or multiple mature females in a habitat causes territorial aggression and fighting.

In a given day, dragons tend to happily and contently hunt for their food and roam their area for intruders. Unmated dragons have an instinct to roam far and wide until they find their mate, while dragons that are already paired will be happy to remain within their lands.

To maintain proper health, a dragon must be able to feel as if it is free to hunt and live without intrusion. They hunt once or twice a day and only from flowing water. They also need fly to keep their wings flexible and expend excess energy. For a place to rest, dragons prefer cave dwellings. For happiness, dragons need a purpose – often, protecting an item or person. Jewels within their cave will do well.



Figure 4 - Image courtesy of MartyMagic.com

Natural Habitats

Lore has varied in the habitats dragons prefer to live in, ranging from extreme desert climates to frigid mountains. The dragons of modern day, however, are mostly temperate to tropical.

Fire-breathing dragons prefer a temperature between 80 and 110 degrees F, though when the temperature rises above 90 they become more aggressive. Ideal humidity is no more than 50% as it inhibits their flame. If temperatures drop below 70, the fire-breathing dragon becomes sleepy and sluggish. As the temperature in nature lends itself to dense foliage and trees, these will be necessary for any habitat that houses this type of dragon. While a dragon may burn some trees and brushes when

they first nest in the area, it is important to allow a dragon the freedom to do so as it will make them feel more at home. They also need waterfalls or flowing streams to drink from.

Frost-breathing dragons are rare in that they prefer a colder temperature between 20 and 40 degrees F with little to no humidity. When temperatures rise above 50, the frost-breathing dragon becomes drowsy and very short-tempered. They need very little vegetation but ground that isn't flat. Their natural habitats are mountains, so the best habitats will replicate hills, caves, peaks, and snow/ice. Their water source can be a very slow moving or frozen stream or pond, as the dragon can break the ice to retrieve a drink of water.

Gas-breathing dragons enjoy moderate temperatures between 60 and 80 with low to moderate humidity. At temperatures colder than 50 they are sleepy, at temperatures hotter than 80 they are aggressive. More humid temperatures allow their gas to permeate and persist in the air longer.

Habitat Design

Pre-requisites

Dragons are beautiful, strong, intelligent, and have the incredible potential to be absolutely devastating. It is for these reasons that the following guidelines be heeded at all times.

- At no point should a dragon ever be forcibly separated from their mate
- At no point should multiple same-gender dragons be placed in the same habitat
- At no point should dragons of different types be placed in the same habitat
- All visible contact with dragons should be minimized unless the human is trained to expect telepathic communication from the dragon (in other words, dragons should never see anyone except trained handlers)
- All safety precautions by dragon type are absolute, non-negotiable, and to be followed at all times

Safe Handling

Dragons are able to “breathe” out their weapon of specialty through glands located on the inside of their jaws. A chemical compound SeFBU (pronounced “safe be you”) can be used to block these glands when injected through the soft patches of skin on their body, located on the side of the necks or directly under the joint where the wings connect to the body, or when inhaled by the dragons in airborne form. The dosage varies by weight, please consult your manufacturer for their specifications.

When a dragon must be handled for transport or for health-related reasons, a dragon can be handled with sedation first, then, SeFBU, restraints to keep their wings from spreading, and a muzzle. We recommend at least 2 handlers for young fledglings under 6, mostly to keep them from biting the handlers or hurting their scales. For dragons between 6 and 15, we recommend 6 to be safe. For dragons between 15 and 30, at least 8 men to ensure the dragon does not simply wrestle away from the handlers.

For dragons older than 30, their strength exceeds a group of humans and once sedated, they must be restrained, muzzled, and placed safely within a cage.

While a dragon cannot breath out fire/frost/gas with a muzzle, SeFBU *must* be administered per recommended dosage consistently to avoid any chance of the dragon breaking the muzzle and wreaking havoc, regardless of age. A fledgling may not have range or as extreme temperatures, but it can still harm handlers if improperly cared for.

We recommend sedation first because a dragon has a reasonable memory and will remember violence incurred against it. This is a good reason for having different handlers at the habitat than those who originally capture the dragon.

Dragons will bond with humans, much like dogs do to their owners. A very close bond allows the dragon to communicate telepathically to the handler, so we recommend using the same handful of handlers for

the dragons consistently. This allows handlers to understand and meet the needs of their dragons and also provides a sense of security to the dragon, rather than the chaos of new people.

Breeding

If you receive a dragon youngling, you must find an appropriate mate for him or her for them to live happily within captivity. Male dragons will instinctually go after females actively ready to mate, but breeding requires an area with a high ceiling, at least 1000'.

Allow the natural cycle of mating, breeding, and dragon hatching to occur. Removing eggs from a mother dragon will cause intense stress and aggression. Fledglings must learn to feed and fly, which are best learned from their parents. At 60 years when it is time for the dragons to leave the nest, they must be moved into a habitat appropriate for their type, but one that is arranged different than their parents' habitat.

Feeding

A dragon must believe they are hunting and feeding themselves. It will be sufficient to maintain and replenish stock as the dragon consumes them; younger dragons will naturally not eat as many large game as an adult dragon, so strive to keep at least one small mammal per 5 square yards 15 large game per square mile. Small mammals include squirrels, skunks, rabbits, beavers, chipmunks, and foxes. Large game include deer, moose, mountain goats, bears, sheep, and coyotes.

Environment

The physical environment of the dragons will depend on the type of dragon being showcased.

Fire-breathing dragons need a temperature set around 85 – 88 degrees F. Humidity between 0 and 20% will keep them happy. It will be best to mimic a tropical forest setting: dense foliage on the flat ground, soft dirt and grass, and tall trees that provide ample shade and cover (most, if not all of the ground should be covered in shade). A stream running through part of the habitat will provide fresh, clean water. A resting cave that is higher up will be warmer and more to the dragon's liking than an underground cave.

Frost-breathing dragons should have a habitat setting that slowly fluctuates between 25 degrees F and 33 degrees F, to mimic changing weather. As little humidity as possible, not to exceed 10% at any given time. The ground should be stone and ice, like a mountain, with very few patches of grass. Lots of peaks and hills made of stone would be good, with a slow stream or frozen pond for drinks. A resting cave should be made from the side of a mountain-like feature going underground.

Gas-breathing dragons will enjoy an even 68-72 degrees F, with humidity 15-20%. They should have tall trees and some grass, more like a Western Washington forest, with some sporadic bushes on the side. Hard dirt, with a few smaller hills. Gas breathers will enjoy a cave that is flat on the ground.

Physical Structure

While the environment inside may vary drastically, most of the physical structure can remain the same. We advise a habitat that is not less than 4M feet squared, though we highly recommend an area of 1 mile squared for having the happiest dragons.

Dragons need to be able to fly, but having them within a pre-defined area is possible as young dragons do not have the strength of full grown adults and adult dragons are mated pairs content to live at “home”. A height of at least 1200’ is strongly recommended, but not to be less than 350’ high.

Technical Details

The environment is created after the physical structure is in place. The structure must be made out of appropriate materials and designed specifically for the type of dragon it is intended to house.

Fire-breathing dragons will need all contact walls and roofs made of material that can withstand temperatures up to 1,700 degrees F minimum, though we recommend material that can ideally withstand up to 2,000 degrees to be absolutely confident in handling all fire-type dragons. The material should not warp with heat, become brittle with heat, or in any way change molecular structure with the heat or quick temperature changes. Material should be thick enough to handle being hit by a dragon while hot without bending. Make any necessary testing of material using a maximum weight of 17,000 pounds at 60 miles per hour.

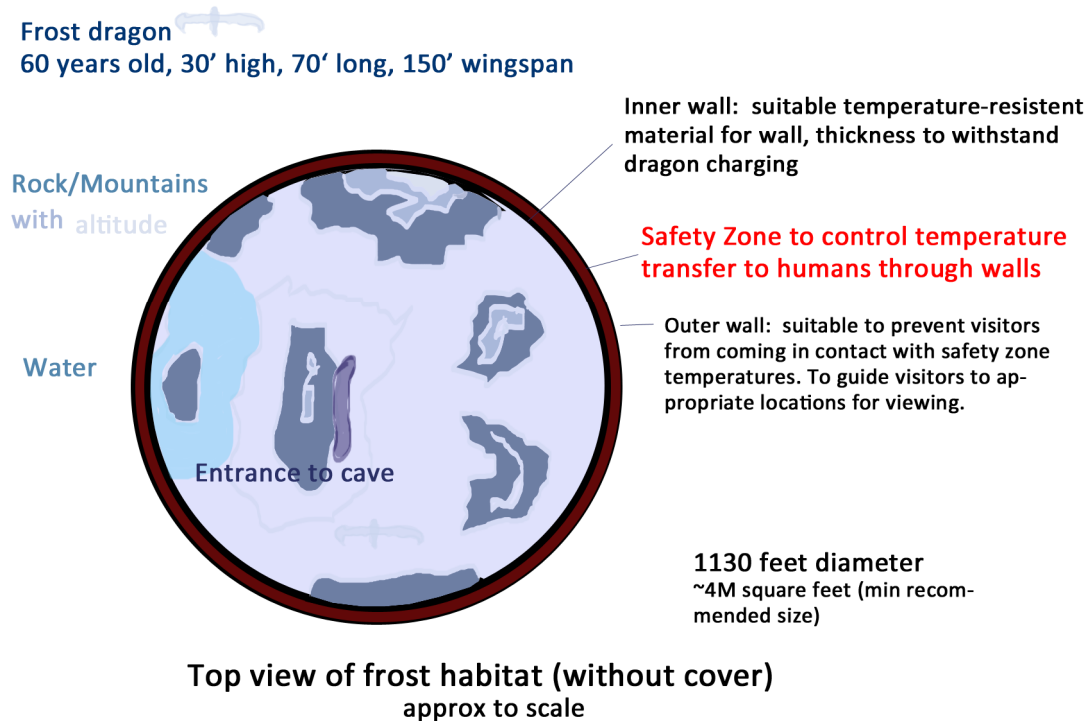
Periodically the habitat will catch on fire: use a rain simulator to put out fires, or strong pressure hoses from walls / roofs. Rain and rainstorms create a sense of realism. It is not necessary to replant or replace burnt shrubbery or grass, fire dragons find scorched earth more like home. Good ventilation to remove smoke is a must.

Frost-breathing dragons need walls and roofs made of a material that can handle -330 degrees F, though we recommend material that is secure to -370 degrees F. The material should not become brittle with cold, or quick temperature changes. Material should be thick enough to handle being hit by a dragon without bending or breaking. Make any necessary testing of material using a maximum weight of 17,000 pounds at 60 miles per hour. The habitat will feel more natural if you can mist water that will freeze to snowflakes.

Gas-breathing dragons will need an airtight surrounding wall and dome made of material that is strong enough to withstand any potential battering from the dragon without breaking or bending. Make any necessary testing of material using a maximum weight of 17,000 pounds at 60 miles per hour.

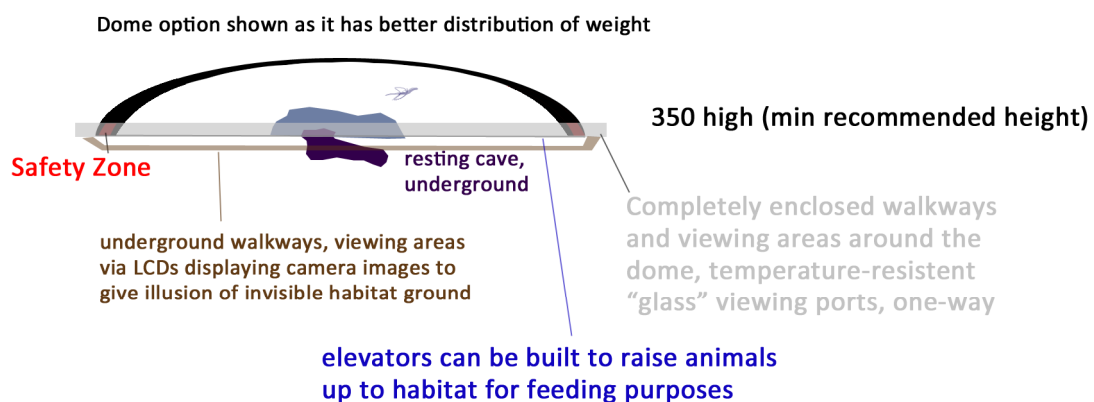
All dragons will need a “safety zone” between the outside of the perimeter of the habitat and any room or zone that will have human occupants. This “safety zone” is a secondary wall that will provide a buffer to prevent temperature transference or gas transference from the habitat to the human-inhabited rooms.

Example Habitat: Frost Type Dragon



Side view of frost habitat

approx to scale in height, skewed in cross-section of walls



A good point of reference for this size is approximately 2.75x larger than CenturyLink Field in Seattle, WA and 1.5x higher. This size is intended for at most one female and male dragon of the same type + any fledglings or young dragons they have together until the young dragons are 60YO.

Safety Precautions

Safety of Handlers

To specifically ensure the safety of handlers, we need to ensure that dragons are not able to harm handlers via physical force or through their dragonsbreath.

We can accomplish this by following these precautions:

- Obeying all recommendations laid out by section labeled Safe Handling.
- At no point should any handler be in the same habitat without SeFBU administered to dragons.
- Whenever possible and whenever the entire body of a handler must be within a habitat, the dragon is to be fully sedated.
- Handlers should remain consistent so the dragon is not agitated further with strange humans in the habitat should they be conscious.
- Handlers of fire type dragons should wear heat-resistant gear, frost type handlers should wear cold-resistant gear, and gas type handlers should wear an oxygen-fed suit that does not allow airborne particles inside.

Safety of Visitors

To specifically ensure the safety of visitors, we need to ensure the dragons will never be able to escape from the habitat and that the dragons have no access to human visitors and customers.

We can accomplish their inability to escape from the habitat with these precautions:

- All habitat perimeter materials must be made of a material suitable and described in Physical Structure: Technical Details. This is critical to preventing the dragon from being able to break free.
- Viewing areas for humans should be made only with material suitable for the type of dragon. The same glass used for NASA Shuttles (aluminum silicate glass and fused silica glass, with an external thermal pane) is able to withstand temperatures as high as 1,800 degrees F (*Spacecraft Design*, <http://www.nasa.gov/centers/ames/research/2007/faq-shuttleglass.html>) and being made to accept temperatures in space as low as -250 degrees F, the material is equally suitable for use with frost dragons. All three types of dragons will require the “glass” used in this viewing area to be thick enough to receive a brute force blow from the dragon.
- Where the glass is impractical, the method used by recent Mercedes-Benz promotions (<http://ponderingtechnology.wordpress.com/2012/03/22/invisible-mercedes-brings-james-bond-technology-to-life/>) would work wonderfully – using miniature cameras within the habitat to take images and display them on LEDs on the outside of the habitat so viewers have the illusion of being able to see the dragon through the wall. This would ensure the dragon did not reach humans.
- Dragon must have an electronic collar worn or surgically implanted in the brain such that should the dragon ever breach the set perimeter boundaries of the habitat without permission, it an electrical current to disable to the dragon or knock them unconscious. This should be regardless

of habitat design to provide a failsafe should the dragon somehow damage the perimeter of the habitat and attempt to roam free.

- All access points into the habitat must be secured by electronic verification and active monitoring by personnel. Any opening of an access point must send an immediate alert for review to active personnel as backup confirmation and verification. This will severely hamper the ability for a human to intentionally get to a dragon or release the dragon.
- At no entry point should a single door allow access to the habitat – there are always to be at least 2 layers of doors per entry point so that there is never direct flow from habitat to the remainder of the zoo. This ensures there is no unintentional direct contact between human and dragon.

We can ensure the dragon has no access to human visitors with these precautions:

- There should be elevators and double-locked access ways that allow personnel to periodically release food for the dragons without ever entering the habitat.
- There should always be an effort to ensure dragons are not aware of the existence of visitors.
- Habitat must be entirely soundproof so the dragons do not hear visitors.
- Habitat must be scent-proof so the dragons do not smell visitors.
- Habitat must not allow dragon to ever view visitors. If a dragon cannot hear or see the visitors, they will not realize they are there and will not be able to cause harm to visitors.
- The inside of the habitat structure should be opaque and look as natural as possible. Walls that are exposed should be painted to appear as if part of the landscape. Any and all viewing areas are strictly one-way viewports.
- All viewing areas and areas where humans are physically near the perimeter of the habitat include the “safety zone” described in Physical Structure: Technical Details so humans will not feel the temperature side-effects of dragonsbreath.
- As a final precaution, all walkways leading to and from the habitat, as well as between viewing areas of the habitat, should be done underground from the habitat or under completely covered enclosures. Should a break of perimeter occur, the breach will occur above ground. Having underground and fully-enclosed walkways will minimize chance of dragons viewing visitors.

Safety of Dragons

To specifically address the safety of dragons, the following guidelines should be followed:

- All manufacturer guidelines for SeFBU and sedation medication should be strictly followed to avoid adverse health effects.
- Dragons should be sedated and restrained no longer than the absolute minimum to complete the necessary tasks.
- Dragons should never be hit, swat, or smacked under any circumstance.
- Dragons should never be informed of visitors, both for the safety of the visitors and for the mental health and happiness of the dragon.
- Dragons should never be teased or otherwise rudely treated. They have feelings too.