



Enclosure Design Information Pack

This pack is aimed for people who require in depth information for course work and also for teachers to aid in their visit to Colchester Zoo.

Contents



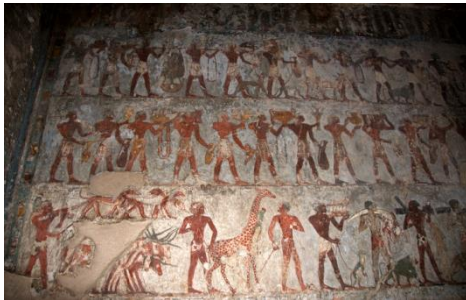
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History of Keeping Animals

As understanding of animals increases and technology advances, the way animals are housed in zoos has changed and will continue to change.

Public attitudes can also affect how animals are housed. What was considered acceptable 20 years ago, may not be accepted now. New laws and regulations further impact on how the animals are housed and managed.

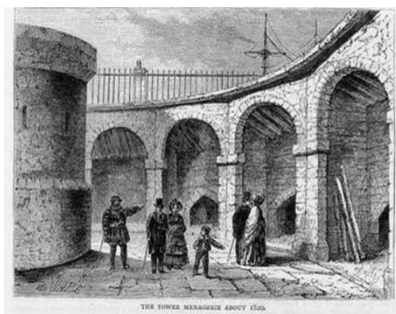
Animals have been kept in captivity for thousands of years for a number of reasons.



In ancient Egypt, animals were a sign of power and wealth, as seen in these paintings.



In ancient Rome, animals were used to fight each other or gladiators for entertainment



From the 13th century, the royal collection was kept at the Tower of London where people could pay to see the animals.



In the 1800's, zoos were places of scientific interest and were more like living museums.

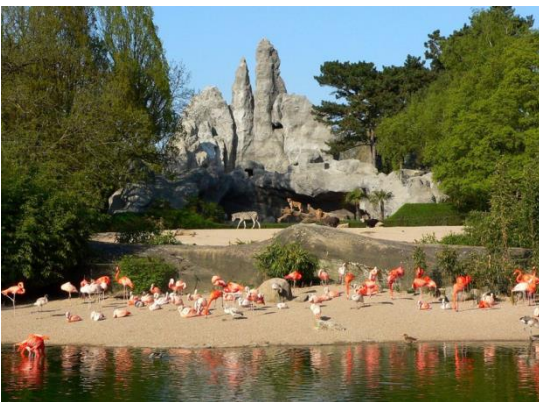
History of Enclosure Design

People's attitudes towards animals and nature has changed since the early days of zoos. Before, the welfare of the animal wasn't a factor in the design of the enclosure and what was considered the acceptable way to keep animals is very different to what is deemed acceptable today.

The three pictures below show some examples of how enclosure design has changed. With a better understanding of animal welfare and the natural world, combined with improvements in technology, enclosures now are very different to how they were and now emphasis is on more natural looking, realistic designs rather than a stylised look.



Animals were kept in a manner that displayed them on show at all times and kept in single species' enclosures. Seen more as curiosities rather than living things.



In 1907, the use of moats and hidden barriers were used at Hamburg Zoo in Germany. This showed animals in a more natural looking environment and showed multiple species in the same area. The first enclosure to do this can be seen in the picture and was so successful, it is still used today.



Enclosures are now becoming more about the whole habitat rather than just about the animal. Some zoos are creating ecosystems with real plants and multiple species of animals. The visitors are often able to use walkways to be in the enclosure. This is called immersion design

Then and Now

The following pictures show examples of how enclosure design has changed. The pictures on the left show how some of the enclosures looked at Colchester Zoo and the pictures on the right show the enclosures now.

The white rhino enclosure late 1980's



The white rhino enclosure late 2000's



The lion enclosure early 1960's



The lion enclosure mid 2010's



The penguin enclosure late 1970's



The penguin enclosure late 2015



Zoos in the 21st Century

In the 21st century, zoos fulfil four main roles:

- Research
- Conservation
- Education
- Recreation

Better understanding of animal behaviour and welfare, combined with zoos focusing on international breeding programmes and education, have all impacted on how zoos design enclosures.

Many zoos are members of national, regional and international zoo associations, all of whom have their own criteria for how animals should be housed and looked after. Colchester Zoo is part of three associations:



BIAZA

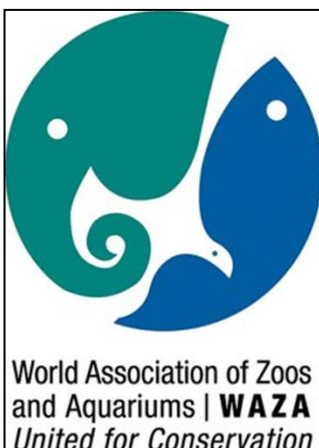
The and Irish Association of Zoos and Aquariaa conservation, education and scientific wildlife charity, ensuring the principles and practices of animal management.



EAZA

The European Association of Zoos and Aquaria is a conservation, education and scientific wildlife association who coordinate breeding programmes within European zoos.

Every continent have their own equivalent of EAZA.



WAZA

The World Association of Zoos and Aquaria provide leadership and support for zoos, aquariums, and associations of the world in animal care and welfare, conservation of biodiversity, environmental education and global sustainability.

Laws and Considerations

Zoos in the U.K. are also subject to U.K. and European Laws.

The EU Zoo Directive and Zoo Licensing Act 1981 state that zoos must:

“Accommodate their animals under conditions which aim to satisfy the biological and conservation requirements of the species to which they belong”

The U.K. Animal Welfare Act 2006:

The Welfare Act 2006 owners and keepers responsible for ensuring that the welfare needs of their animals are met. These include the need:

- for a suitable environment (place to live)
- for a suitable diet
- to exhibit normal behaviour patterns
- to be housed with, or apart from, other animals (if applicable)
- to be protected from pain, injury, suffering and disease

When designing a new enclosure there are several factors that needs to be part of the process, along with the aforementioned laws and regulations.

One key part to remember is there are three groups to consider when it comes to designing enclosures.

- The animal
- The staff
- The visitor

Zoos have to find a balance between all three to ensure the animal has good welfare, the keeper can work safely and that visitors can see the animal, which they have paid to see.

When designing an enclosure, there are several factors that need to be considered.

- What type of animal is it?
- How many animals the enclosure is going to house?
- Physical health
- Mental health
- General maintenance
- Education
- Safety
- Veterinary Care

On a basic level an enclosure should allow the animal to express as many natural behaviours as possible, allow the animal to feel safe and provide education to the visitors.

The Animals' Natural History

The term natural history refers to the behaviour of the animal, the animal's natural habitat and the adaptations they have.

For example, a Patagonian sealion comes from the cold seas off the coast of South America. The seas are cold due to the Humboldt current that comes directly from the seas around Antarctica. They live in groups and spend most of their time in the water. They have thick waterproof fur and a layer of blubber under the skin to help them keep warm.

When designing an enclosure for these sealions, the enclosure must allow them to swim as they spend most of their time in the water and allow more than one individual to live in the enclosure as they live in groups. The water should not be heated as they are adapted to the cold sea, and if the water was warm they would overheat. They will also spend time on land to rest so there should also be a beach area.



For animals that are arboreal (tree dwelling) it is important that they are given the opportunity to climb. This can be done by having actual trees and plants in the enclosure and/or climbing frames and ropes. Climbing frames are useful and allow for complex designs, however, they are solid structures and this can make the climbing too easy for the arboreal animal. The use of ropes will make a climbing frame much more interesting and make climbing a bit harder and thus better for exercise.



Mangabey enclosure



Squirrel monkey outside enclosure

The Animals' Needs

The physical and mental health of the animal must be maintained. This can be done in a variety of ways.

One way is making sure the enclosure is suited to the animals by looking at the animals' natural history as mentioned on the previous page. Animals that burrow and dig should be able to do so, for example. The correct temperature should also be maintained especially for reptiles and species that come from tropical regions. It should also be remembered that animals that come from cold regions are given methods to stay cool and not overheat; this can be done by not having any heating in the enclosure, for example the Amur tiger copes with temperatures of -40 degrees C in the wild so they will often spend most of the day outside during winter and prefer to sleep in the snow. In addition, providing pools to cool off or having a sprinkler system can help animals get more comfortable in very hot weather. Heated rocks and heat lamps can be used for animals that prefer some warm rather than a constant warm temperature.

The correct social grouping is important. Having a solitary animal in a large group will have a negative impact on the animal and having a social animal on their own will do the same.

Regardless of how sociable an animal is, it is important that retreats are available to allow privacy from certain members of the group, but also from visitors. These can be a purpose-built structure or strategic plants to provide cover and visual barriers.



Ensuring the animals have several shelters to get shade or get out of the rain are important. Also it is important for social animals with a hierarchy, which will prevent any low ranking members being left outside.



If the animals are in a breeding situation, having somewhere the mothers can feel safe and rear their young is vital. If the animal makes nests there should be provision of nesting materials, as well as locations to build the nest.

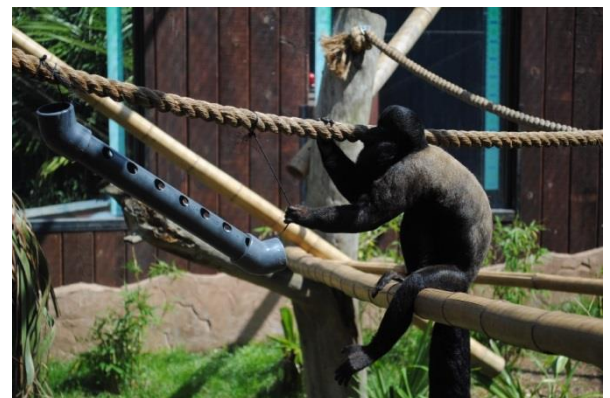


The Animals' Needs

Ensuring the mental health of the animals is met through enclosure design can be achieved by providing opportunities to express as many natural behaviours as possible.

If the animal swims, providing a pool which is large enough and deep enough for them to express this behaviour is important, for example.

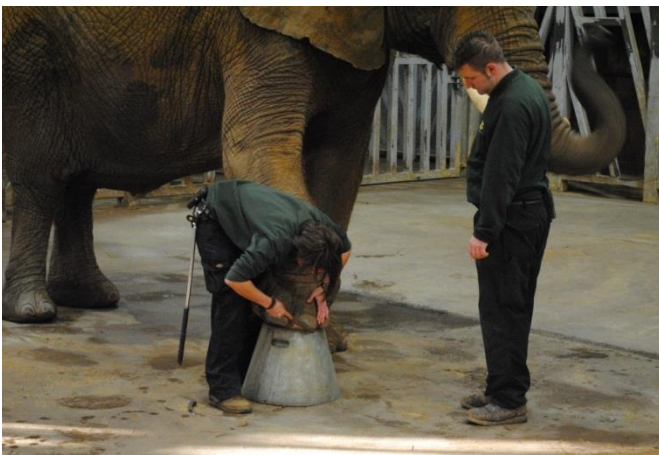
Allowing the instalment of enrichment is vital as well. Enrichment is providing the animals mental stimulation and keeping them active and interested. This can be in the form of puzzles the animals have to work out in order to get food, or novel objects that they can interact with, such as toys. It can also be smells and sounds as well. The pictures below show some examples of enrichment that is done at Colchester Zoo.



Staff Needs

To ensure the health of the animal and that the enclosure is maintained, there are many considerations needed to ensure staff can work in and around the enclosure. These include:

- Safety**—Can the staff work in the enclosure with minimal risk of injury? Are the animals secure to prevent contact that could result in injury?
- Security**—Is the animal secure to prevent escapes and non-staff members entering the enclosure?
- Ease of access**—Can the staff get to all areas of the enclosure? Can they clean and maintain the enclosure easily?
- Clear view of the animal**—Can the staff see the animal clearly in order to do visual health checks and to count the animals?
- Ability to separate individuals**—Can the staff do this quickly and safely?
- Storage**—Can tools be kept safely out of the way? Is there enough room for the staff to move and store food and enrichment items? Can bedding and other such materials be kept in easy reach?
- Prep areas**—Is there a place to prepare food and enrichment?
- Training areas**—Is there a place to safely train animals for health checks?
- Ease of access**—Can all the areas of the enclosure be reached to clean? Can stores be stocked up easily?



Visitor Needs

The visitors are an important group to consider when designing an enclosure. They have paid to see animals, this means a balance between the visitors' desire to see the animal and the animals' need for privacy is important.

This can be achieved by:

- The type of barrier used
- The distance between the animal and the visitor
- Have feed/talk times. This allows visitors to come at a specific time to see the animal.

There is also an opportunity to educate the visitors by making the enclosure look like the animals' natural habitat and signage to tell the visitor about the animal, as well as any conservation work being done.

The visitor needs to be safe to avoid risk of being injured and to ensure the visitor cannot get into the enclosure.

The enclosure should also be accessible to all visitors of any age and ability.

A way to try and encompass all these aspects is through 'enclosure immersion'. This is when the line between the enclosure and the public viewing is blurred. This can be done by making the visitor area look the same, through planting and theming the areas in the same way as the animals' enclosure, and in some cases, using sounds and smells to make a multi-sensory experience for the visitor.



Zoos are in a unique position to raise awareness of the problems animals face in the wild, as well as helping to build a better understanding and respect towards nature.

One way to do this is through the enclosure interpretation. Signs, artwork and interactive signs are used to inform the visitor about the animal, but also of the habitat and conservation issues the species may face. Information on the local people and culture can also be used, helping with increasing the awareness of the world.



Types of Barriers

There are a number of different types of barriers that can be used depending on the species, budget and space available. It is worth noting the type of barrier used, due to the need to keep the visitor out as well as the animal in.

Below are some examples of different barriers with pros and cons.



Uneven Ground:

Pros

- Doesn't obstruct the view of the animals
- Looks natural and blends in

Cons

- Takes up space
- Risk of foot/leg injuries towards the animals



Fine Mesh

Pros

- Unobstructed view
- Doesn't take up much space

Cons

- Can be expensive
- Usually needs another barrier as won't stop visitors putting fingers through



Plants

Pros

- Unobstructed view
- Good for immersion

Cons

- Usually needs another barrier as won't stop visitors putting fingers and arms through
- Takes time to establish



Metal grids

Pros

- Unobstructed view
- Works in all weathers

Cons

- Usually needs another barrier as won't stop visitors gaining access to the enclosure
- Can look harsh

Types of Barriers

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Mesh/bar fencing:

Pros

- Don't take up a lot of space
- Can allow animals to use as climbing (depending on if a roof is included)

Cons

- Can obstruct the view
- Visitors can show negative feeling towards it, as it looks "cage like".



Dry Moat (Ha-ha)

Pros

- Unobstructed view
- Works in all weather

Cons

- Need a lot of space
- Usually needs another barrier as won't stop visitors gaining access to the enclosure.



Water Moat

Pros

- Unobstructed view
- Good for immersion

Cons

- In winter can freeze, allowing animal/visitor to cross.
- Need a lot of space



Stand-off Barrier

With any fence type a stand-off barrier should be used to prevent visitors getting too close to main barrier. This helps in preventing injury to the visitor either from the animal or from falling into a moat.

It can also help in increasing the distance the visitor is from the animal.

Types of Barriers

Barriers can also allow different opportunities to view the animal. The pictures below show other barriers that can be used to allow for the visitor to view the animal in a different way.



Fences

Used to offer unobstructed views and allows the visitors to hear and smell the animals as well.



Under water tunnels:

Ideal to see animals that spend a large amount of time in water.

Having a tunnel is more immersive than a window.



Platforms:

Offers a vantage point for large enclosures and in enclosures that house animals that can climb, it brings the visitor to the animals' level.



Windows:

Can be used instead of mesh or bars to offer a soft look to the enclosure. Needs minimal space and doesn't need a stand off barrier.

Allows visitors of all ages and abilities to see the animal.

Enclosure Size

It is worth remembering one saying when it comes to enclosure design:

Quality not quantity

An enclosure that looks good should also cover the same needs as any enclosure and no matter how much space an animal has, if it cannot use it, it is worthless space.

For example, if there is a group of arboreal (tree-dwelling) primates and they have a large grass enclosure with a climbing frame in the middle, the chances are they will spend their time on the climbing frame and not use the open grass area.

Whereas a group arboreal primates in an enclosure with climbable walls and roof, as well as a climbing frame, would use nearly every part of the enclosure. This is because arboreal primates are 3D animals, this means they will use all parts of their environment compared to a 2D animal such as a white rhino that can only use the floor area.

Visitors will also judge how an animal is kept by how the enclosure looks. This has been a subject for many scientific papers. It does not matter how well the enclosure works for the animal and staff, if the enclosure doesn't look nice the visitor will think the animal is not being looked after properly.

One concern that visitors have is that the animal doesn't have enough space compared to the space they may have in the wild. The size of a territory or areas used by the animal is due to the availability of resources.

In the wild if a water source, a food source and, if needed, shelter are close by, the used area will be small. If the resources are far apart the area will be larger.

The key point to remember is in captivity enough space should be provided that allows animals to have privacy, allows animals to move themselves away from other individuals and to allow the expression of as many natural behaviours as possible.



Mixed Species Enclosures

A way that animals can be housed is in a mixed species set up. This is where more than one species are kept together. The species that are mixed are from the same habitat and are found living in close proximity to one another in the wild.

There are several factors that need to be considered when housing multiple species in the same space.

- Large enough space to allow the species to move away from each other
- Multiple feeding areas
- Multiple drinking areas
- Areas to introduce new arrivals safely to the other species
- Barriers that are suitable for all the species
- The different species should have their own house or area within a larger house
- Predators and prey should not be mixed

When setting up a mixed species enclosure, it is worth remembering that individuals may not suit this environment and that mixing the different species will take time.

During breeding seasons, some species may need to be removed if males are sparring. This avoids other species getting caught in the crossfire.

Mothers with young may need to be kept away from other species to avoid injury to the young and mothers will be more protective of their young and thus show higher levels of aggression towards other species.

At Colchester Zoo, the largest mixed species enclosure is The Spirit of Africa, which houses a herd of giraffe, a breeding group of white rhinos, a flock of ostrich, a group of kudu antelope and zebra and a flock of crowned cranes.



Other mixed species enclosures at Colchester Zoo include:

- **The Rainforest Walkthrough** with golden headed lion tamarins, Geoffroy's marmosets, two-toed sloths and, on warm days, green iguanas and tortoises.
- **The Worlds Apart Walkthrough** with two-toed sloth, golden lion tamarins and titi monkeys
- **Colenso Village** with pygmy goats and Cameroon sheep
- **Lost Madagascar** with red bellied lemurs, red ruffed lemurs and ring tailed lemurs
- A variety of fish are also mixed together in fresh water tanks or marine tanks around the zoo
- Binturongs and short clawed otters
- Weavers birds and tortoises



Filter Systems

Animals that spend a large amount of time in water need to have the water filtered to ensure the water is clean and safe for the animals. Below is a walkthrough of the filter system used at the sealion enclosure at Colchester Zoo. The same method of filtration system is used for the penguins, otters and fish just on a smaller scale.



Water is pumped from the outside pool into the filter system via 5 pumps.



The water is then pumped through a sand filter (the large green rounded unit).

This is where physical particles, such as leaves and solid sealion waste, is trapped and removed from the water.



The water is then passed through an Ozone machine (pictured left), which uses O₃ to kill off parasites, and microbes that are harmful to the animal. The protein skimmers (pictured right) work with the Ozone to eliminate more harmful microbes and help remove algae.



The water is then passed through UV lights (the stack of white tubs on right of the picture). This removes the O₃ from the water and can also help with removing any additional microbes.



The water is then passed through a biological filter (built within the waterfall), which uses safe bacteria to re-populate the water and further help with the removal of harmful bacteria.

The water is then returned to the pool via the waterfall (pictured left). Having the water returned via a method that breaks the surface layer of the water helps to keep the water oxygenated, which is vital for fish.

Points to Remember

Overall, there are many considerations that need to be taken into account when building an enclosure. The following list is a recap on these aspects, as well as additional points.

- Enclosure should suit the natural history of the animal
- The welfare and wellbeing of the animal is paramount
- The animal should feel safe
- The animal shouldn't be able to leave the enclosure
- Visitors should not be able to enter the enclosure
- The staff should be safe at all times when working in and around the enclosure and animal
- There are laws and regulations that need to be met
- Need to find a balance between the needs of the animal, the staff and the visitor
- The enclosure should allow veterinary and health care to be carried out
- The placement of enrichment should be able to be done with relative ease

Other considerations to think about:

- Is there the possibility of breeding in the future?
- How much of the enclosure will the visitor see?
- How are the visitors going to view the animal?
- What type of signage will be at the enclosure?

Ideally the enclosure should reflect the wild environment that the animal comes from, which can be achieved by using furnishings, such as plants and rocks in the enclosure. This will encourage natural behaviours such as climbing, foraging and digging.

Temperature, lighting and humidity must also be suited to the specific animal. Animals that come from tropical climates need a higher constant temperature compared to animals that come from a temperate climate. Animals that come from tundra areas will not need heating as standard, as the natural temperature in the U.K. won't reach the same lower temperatures.

Animals that are cold blooded (ectothermic) will require a higher temperature compared to a warm blooded (endothermic) animal.

Humidity is important for reptiles to maintain good skin health and aid in shedding. However reptiles that come from very arid areas may benefit from lower humidity levels. The humidity of nesting areas for birds may need to be monitored if nesting inside, as the level of humidity can affect the egg and the chick's development. In general however the humidity level for adult birds and mammals does not need to be strictly regulated.

UV in the form of lighting is also an important factor for reptiles to maintain healthy bones and all animals being provided with natural sunlight is also important. This is also important if there are live plants in an indoor enclosure.

Ventilation is also important. If animals have straw or hay, the area should have air flow to prevent a build up of fungal spores. Ammonia from animal waste can build up in poor ventilated areas as well.

Overall the specific temperature, humidity and light is dependant on the species.

A useful website to visit is called Zoolex. Here is a link to their website: <http://www.zoolex.org/>

Enclosure Design: Patagonian Sealions

Playa Patagonia is one of the largest construction projects undertaken by Colchester Zoo. The whole project cost over £1.8 million and was opened in August 2003. Playa Patagonia is the largest saltwater sealion pool in the UK. It also has the longest underwater viewing tunnel at 24 metres long.

Indoor:

Consists of four stalls, each 16m². They can be sectioned off with the use of hatches, but usually they are left with access to all four. They have access to a smaller outdoor pool when they are in their indoor enclosure, which can also be used as a nursery pool. This pool is approx. 2ft deep and at its widest part it is approx. 15ft.



Outdoor:

The outside enclosure is 456m²; the pool is 4m deep and has a capacity of 550,000 gallons of water.

There is also a beach area for the sealions to rest and bask on and is large enough for all the sealions to use at once.

The filtration of the water is a closed system, which means the water is recirculated, meaning water is recycled and then put back into the pool. The pool also has a sand filtration system to catch solid particles and the Ozone units alongside a UV system to sterilise the water which is returned to the pool via a waterfall. The pool is saltwater and does not use chlorine, which avoids health problems such as skin irritation and eye ulcers.



In the outside pool, there is a tunnel which runs the whole width of the pool which the public can walk through. After the tunnel, there is further viewing into the pool via large windows. Along this part is a variety of signs and information on the ocean in general, as well as raising awareness of the affects of overfishing. Along the perimeter above the pool are glass viewing windows overlooking the surface and onto the beach area.

The keepers also do training with the sealions in the outside enclosure so there is flat rockwork and space where this can be done.



Enclosure Design: African Elephant

Colchester Zoo has 3 adult females and 1 adult male African elephant in the Elephant Kingdom enclosure. This enclosure was designed as a breeding facility and, to date, two elephants have been born and reared in the enclosure. Elephant Kingdom opened in 1998 and at the time cost £750,000 to construct.

Indoor:

The indoor area is split into two halves. One side is for the females and the other side for the male. Males are naturally solitary, hence the separate area. The female area is 457.5m² in size and has a large sand area and elevated hay racks and scratching posts. There are also stalls that allow individuals to be secured safely, for example for veterinary procedures. The female side is visible to the public via large windows

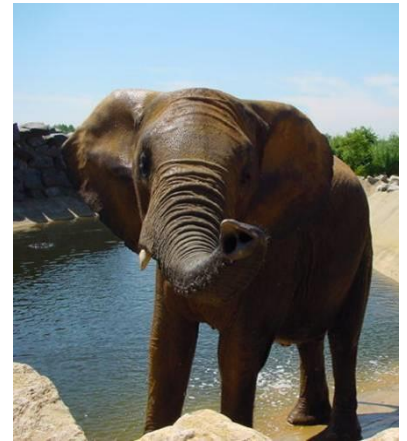


The male's area is 256m² and also has a sand area as well. There is also a large stall that allows the keepers to do health checks and care whilst being safe. Elevated hay racks and scratching posts are also present in the male's area.

The two halves can be joined and females can be housed with the male.

Metal cables are used to keep the elephants away from the glass and don't obstruct the visitors' view into the house.

The house is kept at 18 degrees C with mounted radiators to keep them out of reach of the elephants.



Outdoor:

The outside area consist of two paddocks. The female and the male paddock. The female paddock is visible to all visitors and the male is visible via a road train. The paddocks are surrounded by dry moats and have boulders running along the side to prevent the elephants from entering the dry moats and a small electric fence to prevent the elephants from the moving the boulders. A stand off barrier and planting prevents visitors gaining access to the paddocks.

Both paddocks have large walk in pools with waterfalls. The females 'paddock covers an area of 4806.8m² and has a large shelter to offer shade in the summer. The male's paddock has an area of 2681.6m². There are also hay racks and feeding posts in both paddocks.



Enclosure Design: Amur Tigers

The Amur Tiger exhibit 'Tiger Taiga' was opened in 2003. As tigers are classed as a dangerous animal and being the top predator in their natural range, the keepers do not have any physical contact with the tigers. In order to keep the keepers safe and work around the tigers, the enclosure has a system of doors that can be opened or closed and secured from the outside of the tigers' area. A two door system is also used, which means at least one door is closed at anytime and thus maintains the perimeter.

There are two separate outside areas and indoor areas which can be operated as two separate enclosures if needed. Tigers are normal solitary and females with cubs would stay away from males. Having this system allows for future breeding and, if the two tigers prefer to be alone they can be managed as such.



Indoor:

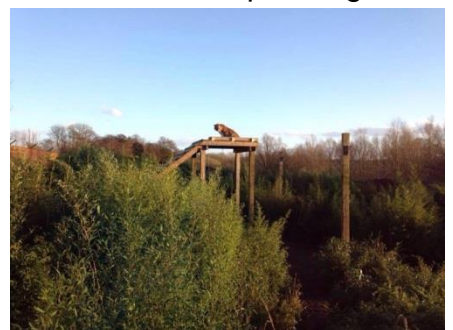
There are two separate indoor areas, one which visitors can see into and the second house has no visitor access. Both houses are split in two areas that measure approximately 4m x 4m with a raised platform in each, which also double up as cubing dens. As Amur tigers are adapted to cope with temperatures ranging from -40 to +22 degrees C in their natural habitat, the houses are not heated unless for veterinary reasons. The heaters are mounted to the top of walls out of the tigers reach. Vents are built into the walls and allows ventilation without comprising the perimeter.



Outdoor:

The outdoor area is also split into two areas which can be joined together or kept separate; this facilitates management and cleaning of the enclosure as the tigers can be locked in one side whilst the keepers clean in the other. The larger side measures approximately 40m x 40m and the other side is 40m x 20m. A raised public walkway runs down the enclosure separating it into two halves.

There is also a tunnel system which leads to the indoor houses and is accessible from both outdoor enclosures. This has openings at both ends so the tigers can get inside from both outdoor enclosures, however, it can also be split up with more mesh so that they do not have to meet if they are managed separately.



The enclosure has grass planted throughout and tall planting to provide cover and shade in the warm weather. Bamboo is used as it is fast growing and flexible enough for the tigers to go into it and not damage the plant. The enclosures have pools to provide opportunities to remain cool in warm weather and tigers enjoy interacting with water regardless of the temperature. Log piles and feed poles are also present, as well as a large platform in one side to provide a vantage point for the tigers.

Enclosure Design: Orangutan

Orangutan Forest was built in 2009 at a cost of £1.75 million. Not just home to the orangutans, there is a marine fish tank and a fresh water pool with pond turtles and fresh water fish which are found in either Borneo or Sumatra where wild orangutans can be found. There are also a variety of live plants growing within the building.

Indoor:

The indoor part for the orangutans is divided into two main areas. The night area is made of three self-contained night quarters. These can be used as one area or divided with the use of sliding doors. The total area for the night quarters is 60m².



The second part is called the day area and is one large area with a large climbing frame and contains a second level half way up. The total area for the day area is 150m².

In both parts, additional climbing opportunities can be added, such as ropes and hammocks, as well as other forms of enrichment.

The visitors view the two areas through reinforced windows, which run along the front.

Outdoor:

There is one outside area which contains a waterfall and pool as well as heated rocks and climbing frames covering an area of 404.6m²

Viewing for the outside is through floor to ceiling reinforced windows which are 4 metres above the enclosure floor.

Orangutans are classed as a dangerous animal and the keepers cannot go in with them. All slides and doors are operated from outside the area and the keepers are able to secure the animal in one part of the enclosure to allow the cleaning of another part.



The building is kept at a temperature between 18-25 degrees C. and is maintained with the use of heaters. To prevent the building getting too hot, the roof panels can be opened. Water misters are used to maintain a high level of humidity for the plants and aid in their watering.

The orangutans have access to the outside throughout the year. On occasion the doors may be shut to the outside to prevent drafts on particularly cold days.



Enclosure Design: Komodo Dragon

Dragons of Komodo enclosure was built in 2006 at a cost of £900,000, to house two adult Komodo dragons as well as a provide breeding opportunities and house young Komodo dragons.

The enclosure is a large 'greenhouse-style' building which covers an area of 350 metres squared, divided into two main areas, which are 120 metres squared each, with two smaller areas, which are both 24.5 metres squared. There are also two off-show dens, which are 10 metres squared each. The rest of the enclosure is made up of the keeper areas. All areas can be closed off from each other or opened through.

Inside, the enclosure incorporate multiple retreat and basking areas, facilities for the creation of nesting areas and a variety of visual barriers. The exhibit can be sectioned off into two fully complimented enclosures so the animals can be kept separately if necessary. (i.e. adults away from young or the enclosure has a male and female).

The sliding roof is made from UVA and UVB transmitting panels, which can be retracted to exchange air in the enclosure and to let in natural sunlight to give the dragons the vitamin D3 that they need. The enclosure is also heated with a mixture of independently operated underfloor heating systems, heat lamps and radiator systems.

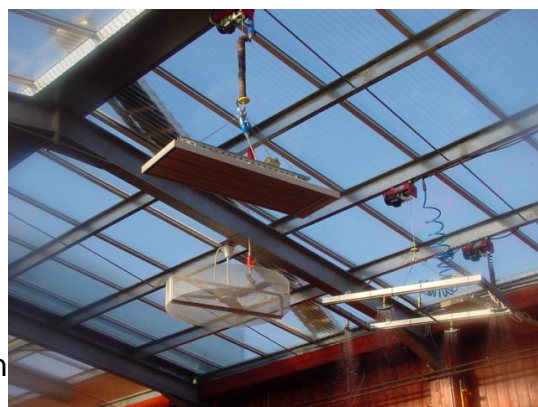
The enclosures ambient temperature is between 20-30°C. The warmest parts of the enclosure are between 35-40°C.

In combination with the heating, a sprinkler system is used to help adjust humidity levels when required and replicate wet and dry seasons of the dragons natural habitat. On average humidity is kept at 60-70%.

A 12 hour day and 12 hour night heating system is implemented with a warmer day and a cooler night. In addition variation in temperature is applied to mimic varied natural conditions in the wild. Fans are also used to circulate the air around the enclosure, drawing air to the ceiling or pushing air down to ground level where necessary.

Lighting is provided by a combination of Halide floodlights, natural sunlight filtered through the roof system and the Perspex windows and additional UV lights

The floor is covered in a soft substrate, which permits natural digging and foraging activities and is non-abrasive to the Komodo dragons' feet and tails.



Enclosure Design: Lorikeets

The Australian Rainbows walkthrough enclosure was built in 2014 to house a flock of rainbow lorikeets and enable breeding to take place. The enclosure allows visitors to walk in the large aviary with the lorikeets free flying.

Covering an area of 220 metres squared, the main part of the enclosure is made up of one large aviary that visitors can walk through and smaller off show aviaries.

The main aviary has real planting throughout that the lorikeets have access too as well as several wooden and metal perches.

The visitors follow the path around the edge of the aviary with a barrier to ensure the visitor stays on the path. To ensure the lorikeets stay in the aviary but the visitors can still come in, there is a two door system in place. This allows the perimeter to be maintained. There are also heavy plastic flaps over the door to prevent the lorikeets from flying or walking through the doors. These flaps also help to maintain the temperature by decreasing heat loss.

The main aviary is fitted with CCTV to allow staff to monitor the visitors in the aviary as well as the lorikeets. On days when there are high visitors numbers, a volunteer or staff member will be in the aviary as well. This allows the staff to monitor the lorikeets and visitors to ensure the well being and welfare of the lorikeets is maintained to the highest possible standards.

The roof of the main aviary is made of Perspex to allow UV to pass through for the health of the lorikeets but also to maintain the plants.

The enclosures heating is controlled through a combined digital heating and cooling system, which maintains the enclosure at 24°C.

There are 6 off show aviaries. 3 of which are inside and 3 that are outside. These aviaries can all be linked or be separated from one another if required.

These off show aviaries allow the lorikeets private areas away from visitors, as well as allow new lorikeets to be introduced into the flock. They also enable the keepers to secure the lorikeets away from the main aviary if the main aviary needs any maintenance work or a deep clean.



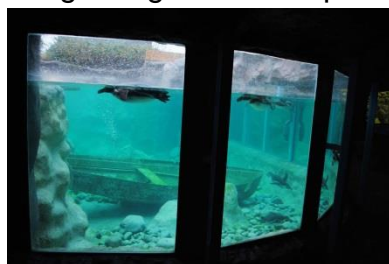
Enclosure Design: Humboldt Penguins

Colchester Zoo has two Humboldt penguin enclosures. The oldest is Penguin Shores, which opened in 1994 and the second is called Inca Trail, which opened in 2006 and was redeveloped in 2015. This was done to increase the useable space for the penguins as well as improve the opportunity for visitors to see the penguins. Access and visitor information was also updated to allow all visitors to learn more about Humboldt penguins, their habitat and conservation.

Penguin Shores

Built in 1994 and covers an area of approximately 90m², of which 42m² is the pool, which has a depth of 2 metres. The land area is covered in large smooth pebbles on a concrete base to aid in drainage and cleaning. Rock affect nest boxes are provide away from the edge of pool and simulate the burrow nests found in the wild.

Visitors are able to view the penguins from one side of the enclosure over the land area. This enclosure also has under water viewing along one of the pool sides offering a unique view point.



Inca Trail

Built in 2006 and redeveloped in 2015, it covers an area of approximately 219m² of which 80m² is the pool, which has a depth of 1.5 metres. The land area is covered in large smooth pebbles on a concrete base to aid in drainage and cleaning. Rock affect nest boxes are provide away from the edge of pool and simulate the burrow nests found in the wild.

Visitors are able to view the penguins from above on two sides with an extended viewing platform going over some of the pool. The enclosure perimeter is panelled glass to increase the opportunity for all visitors, regardless of age and ability to view the penguins.

This enclosure also features a sanded area for the penguins to use, offering more space and allows the visitors to see the penguins up close. This area also has a perimeter of glass panels to improve visitor viewing access.



Both enclosures use a filtration system in the same way as the sea lion enclosure but on a smaller scale. The filtration of the water is a closed system. The water is recirculated, meaning water is recycled and then put back into the pool. The pool also has a sand filtration system to catch solid particles and Ozone units alongside a UV system to sterilise the water which is returned to the pool via a waterfall. The pool is saltwater and does not use chlorine, which avoids health problems such as skin irritation and eye ulcers.