ANIMAL INSIDE OUT

A BODY WORLDS Production

EDUCATION EXHIBIT OVERVIEW
<table>
<thead>
<tr>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WELCOME—a letter from <em>ANIMAL INSIDE OUT</em></td>
</tr>
<tr>
<td>The mind behind the exhibition</td>
</tr>
<tr>
<td>Q&amp;A with kids</td>
</tr>
<tr>
<td>Exhibition overview</td>
</tr>
<tr>
<td>Amazing facts</td>
</tr>
<tr>
<td>Planing your visit—chaperone responsibilities</td>
</tr>
<tr>
<td>Note to educators—strategies to help the educator come prepared</td>
</tr>
<tr>
<td>Essential questions</td>
</tr>
<tr>
<td>FAQ</td>
</tr>
</tbody>
</table>
Dear Students,

Did you know that giraffes are the tallest mammals on earth, ranging in height from 14-19 feet? Can you imagine that the heart of a bull is five times larger than that of a human? While our own bodies are capable of some pretty amazing feats, all animals have their own traits, characteristics and incredible skills that make them unique.

The specimens presented in “ANIMAL INSIDE OUT, a BODY WORLDS Production” were created by German anatomist, Dr. Gunther von Hagens, inventor of the revolutionary Plastination process. Thanks to the donation of various animals from zoos and other institutions, we began our work on the specimens you will see in this one-of-a-kind exhibition, intended to help people understand more about the animal kingdom through anatomy.

When you visit with your school or family, you will see how intricate the blood vessels of animals are, what the muscular system and various organs of different animals look like and how they compare to other animals, including humans. ANIMAL INSIDE OUT will show you why giraffes have such long necks, reveal why camels have humps and how the hoofs of certain animals make them better equipped to navigate the terrain of their native habitats. Combined with the activities inside this guide we hope you will learn more about the anatomy of animals and how each species, large and small, plays an important role on our planet.

Albert Einstein once wrote that we should widen “our circle of compassion to embrace all living creatures and the whole of nature and its beauty.” The animals presented in ANIMAL INSIDE OUT—wild, exotic, domestic, previously unknown and even those familiar to us, offer a glimpse into the biology and diversity on our planet. The plastinated specimens are our contribution to the epic on evolutionary biology and the diversity of life on our planet.

It’s my sincere hope that you enjoy this anatomical safari!

Dr. Angelina Whalley
Creative & Conceptual Deisgnr
ANIMAL INSIDE OUT, a Body Worlds Production
Animals have fascinated me all my life.

As a child, I was enthralled by the small animals I encountered in the woods. The first specimens I dissected were beetles, frogs, and other small animal corpses that my friend, Dietrich and I found during our jaunts to the woods. These deaths which were so random and yet so normal must have colored my view of death and shaped my thoughts on mortality, preparing me psychologically for my career as an anatomist.

My childhood years were filled with a certain awe for nature and the varieties of life that populated it. But in my teenage years, my interest in biology was replaced by an interest in electronics and space. I became the resident expert on all things related to Sputnik, and soon in the gadgets I saw in early James Bond films.

Later as an adult, I renewed my relationship with animals by frequently visiting zoos and aquariums. The larger than life animals I admired—giraffes, elephants, and gorillas—were filled with a controlled grace that I found wondrous.

They lumbered, they sauntered, they ambled, their elegance so surprisingly disproportionate to their size. In the last decade, I have traveled to Africa and Antarctica to see up close the creatures that had captured my childhood imagination.

In an accelerated technological age, when our environments are fashioned from steel and concrete, being in close proximity to animals—both domestic and wild—return us to authenticity. Outside of the rainforests and flora, they and we are the last remaining pieces of nature. They are our co-habitants on this spinning blue globe. This exhibition, ANIMAL INSIDE OUT, is both a celebration and an homage to animals both familiar and rare.

Dr. Gunther von Hagens
Anatomist, Inventor of Plastination and
Creator of ANIMAL INSIDE OUT, a BODY WORLDS Production
Were you ever scared to work with dead animals and bodies?

**Dr. von Hagens:** When I was a child I spent my time in the woods, chasing frogs and listening to the sounds of animals in the forest. Occasionally, I would find small, dead creatures—like beetles and snakes, which I would take with me to dissect. I was always curious to see what they were like on the inside.

When I was about six years old, my jaunts in the woods came to a halt. I became very sick and nearly died. I was in hospital for many months and became very comfortable in that environment of the sick and dying. The doctors and nurses who cared for me became my heroes, and I wanted to become like them. Later when I worked in a hospital as an orderly and then a nurse, (long before I became a doctor), one of my duties was to transport the dead to the morgue. Other workers didn’t like this job because it frightened them, but I was never afraid. Being afraid of death is not a good way to live.

What is the largest animal you have ever plastinated?

**Dr. von Hagens:** For years now, I have been working on plastinating animals. A few years ago, I plastinated not only some smaller animals, but some large ones, such as a horse (2000), a camel, and a gorilla (2003). In particular, these large animals require all of my imagination. The larger they are, the bigger the anatomical and technical challenge they present. When I completed the plastination of these animals I was certain that they would be the largest animals I would ever plastinate, however, to my great surprise and honor I was donated two elephants by the Neunkirchen Zoo in Germany, in 2005. The animals died in captivity—one of
old age and the other of heart failure. The whole process to transform the two elephants took four and five years respectively. Through the challenges and obstacles faced to transform them I must admit that they certainly have allowed a view of elephants never seen before. I now presume they are the largest animals I will ever plastinate, but I hesitate to say I'm completely certain.

What have you learned from plastinating animals?

Dr. von Hagens: I have discovered many new aspects of anatomy when working on the plastination of animals giant and small. My team and I dissect animals in a detailed and careful manner that surpasses previous preservation techniques. In doing so, I feel like a researcher on an anatomical journey of discovery. For example, we have been able to show how the underside of a giraffe’s skin is more vascularized where it has dark spots, compared to the areas where it has lighter fur. This has never before been shown so clearly, as no one else previously has injected an entire giraffe with a contrast enhancing resin that penetrates even the minute arteries of the skin, as we have done.

Where did the idea for BODY WORLDS & ANIMAL INSIDE OUT come from?

Dr. von Hagens: When I used to teach anatomy to students in medical school in the 1970s, I had to use illustrated anatomy atlases and picture books to show the organs and body systems. I tried to use real human organs and specimens, but at that time the specimens were preserved in blocks of plastic so you could not touch them, or study the placement of the organs properly. I realized one day that if the plastic was inside the body and not outside it, the specimen would be rigid and easy to grasp, and study and work with. I was only trying to solve a problem, I wanted to educate my students so they would become better doctors, as I don't think doctors should be poking around inside your body and operating on you if they don't know important things about it. But something very unusual began to happen after I began to plastinate organs and specimens. The janitors and secretaries and office workers at the university began to stop by the lab; they were fascinated by the plastinates. This was when I began to think of anatomy for lay people, which is what BODY WORLDS is. It is very different from anatomy for medical professionals because it has to be interesting and dynamic and not scary to look at.

In the human BODY WORLDS exhibitions, curator Dr. Angelina Whalley and I decided to incorporate some animal specimens. Visitors often found them as fascinating as human specimens. This led us to come up with the concept of ANIMAL INSIDE OUT.

How long does it take to prepare the specimens for display?

Dr. von Hagens: Plastination takes a very long time. A whole-human body can take up to 1,500 working hours to prepare. Larger animals like elephants, giraffes and horses can take three years or more. Smaller specimens and slice specimens take an average of 3-6 months depending on the size and level of dissection.
EXHIBITION OVERVIEW

Travel on an anatomical safari

Explore the intricate biology, zoology and physiology of the world’s most spectacular creatures, large and small in this fascinating new exhibition by BODY WORLDS creator, anatomist Dr. Gunther von Hagens.

*ANIMAL INSIDE OUT* takes visitors on an anatomical safari of more than 100 specimens. Each animal is painstakingly preserved by the remarkable process of Plastination, invented by Dr. von Hagens.

From goats to giraffes, elephants to eels and octopuses to ostriches, visitors will discover the form and function of animals both exotic and familiar. Animal biology textbooks spring to life in this unforgettable museum learning experience.
Giant squid can snatch prey up to 33 feet (10 meters) away by shooting out their two feeding tentacles, which are tipped with hundreds of powerful sharp-toothed suckers.

Sharks have been swimming the seas for 400 million years—longer than dinosaurs have been walking the earth.

Sea scallops grow rapidly during the first several years of life. Between the ages of 3 and 5, they commonly increase 50% to 80% in shell height and quadruple their meat weight.

The maximum speed of a snail is 1 mile a week or about .006 miles an hour.

Mackerel, unlike any other species, are likely to die if their incredibly thin and specialized skin is touched by human hands. It is theorized that it may be the oils in human hands.

Most cuttlefish are capable of changing colors and can bury themselves in the ocean sand very quickly.
Frogs don't need to drink the way humans do: they absorb water through their permeable skin!

A bull’s heart is around 5 times heavier than a human heart.

The combination of the cat’s inner ear (vestibular apparatus) and tail provide the cat with its incredible balance and acrobatic prowess.

Giraffes are the tallest mammals on earth, ranging in height from 14-19 feet.

An adult bull giraffe can feed on the leaves of trees over 19 feet above the ground!

Chickens can travel up to nine miles per hour.

Reindeer have long, coarse hair with hollow cores, which keeps them insulated in colder climates.

Reindeer are very strong swimmers and can travel across wide, rapid and frigid rivers.
Thank you for volunteering to be a chaperone on your school’s visit to ANIMAL INSIDE OUT at The Leonardo Museum. Being a chaperone is a great way to enjoy your visit and it is also an important responsibility. As a chaperone, you are responsible for helping your students get the most out of this amazing learning experience. This guide explains the Museum’s school visit expectations:

- All adults accompanying a school group to the ANIMAL INSIDE OUT exhibit are responsible for students behavior and experience (this includes teachers).

- Please ensure that you and your group of students (12 students per Leo Policy) stay together during your time in the ANIMAL INSIDE OUT exhibit and in the Museum.

- While your students are engaged in learning, questioning and reflecting on the exhibit, we ask that you help us reinforce some basic museum etiquette:
  
  o Keep your voices low.
  o No running in the exhibit or in the Museum.
  o Do not gather at the entrance or exit of the exhibit.
  o Groups with poor conduct may be asked to leave.
  o Do not block the flow of traffic for our other visitors.
  o No photography or filming while viewing ANIMAL INSIDE OUT.
  o Some teachers may take advantage of the unique learning opportunity by requiring students to complete assigned activities. Please remind students not to lean on the specimen cases or touch the specimens. They should use a notebook or clipboard to fill out their papers.

We know that this is a fascinating exhibit to view, but please remember your top priority is to monitor and remind your students of the Museum’s expectations to ensure a positive experience for everyone.
NOTE TO EDUCATORS

STRATEGIES TO HELP THE EDUCATOR COME PREPARED

The Leonardo has compiled a list of suggestions to help you come prepared for the *ANIMAL INSIDE OUT* exhibit. These suggestions will enable you to prepare your students and adult chaperones for their *ANIMAL INSIDE OUT* experience.

- Reserve your tour for *ANIMAL INSIDE OUT* with school group reservations. Please contact The Leo at 801-531-9800 ext 103 or email education@TheLeonardo.org

- Educator materials are available for pre/post student learning that correlate with the exhibit and Utah State Office of Education Core Curriculum (USOE). Many of the lessons have a component that can be completed while viewing the exhibit.

- Review student behavior expectations with your students prior to your visit:
  - Keep your voices low.
  - No running in the exhibit or in the Museum.
  - Do not gather at the entrance or exit of the exhibit.
  - Groups with poor conduct may be asked to leave.
  - Do not block the flow of traffic for our other visitors.
  - No photography or filming while viewing *ANIMAL INSIDE OUT*.
  - Some teachers may take advantage of the unique learning opportunity by requiring students to complete assigned activities. Please remind students not to lean on the specimen cases or touch the specimens. They should use a pencil and notebook or clipboard to fill out their papers.

- Review adult chaperone expectations with your adult chaperones prior to your visit. These expectations can be found in “Chaperone Responsibilities”

- [www.animalinsideout.com](http://www.animalinsideout.com) is a great resource to answer student questions about the plastination process.
Strategies for Teaching in the Exhibit

*ANIMAL INSIDE OUT* is an amazing opportunity for educators to use as a teaching tool and for students to make meaningful connections with classroom material in an informal setting.

The exhibit is relevant from kindergarten through college.

The Leonardo has developed educator materials that correlate with the exhibit. These lessons are aligned with the Utah State Office of Education Core Curriculum (USOE).

The Table of Contents lists the lessons the Museum has developed and the grade level content the lessons are aligned with.

Animal adaptations, body systems, anatomy and physiology are core concepts that easily align with the *ANIMAL INSIDE OUT* exhibit.
ESSENTIAL QUESTIONS

1. How are animal groups anatomically similar?

By examining and comparing the anatomy among species, similarities and differences are observed, establishing a relationship between species. When characteristics are shared among a large number of similar species, they are viewed as ancestral. While those limited to one or a few species are viewed as derived. The comparison of a variety of characteristics possessed by similar species allows scientists to differentiate between species that are truly closely related and those illustrate the interconnectedness ANIMAL INSIDE OUT encourages the visitor to make the connection of how living things are more alike anatomically than what can be seen externally.

2. Do animals in nature have anatomical similarities to humans?

All species are similar at the molecular level. They are made of a cell or cells, surrounded by a plasma membrane and containing DNA and RNA. There are 500 genes common to all species (Utah) it’s the combination of the other thousands of genes that allow for such great diversity present on Earth today. The main goal of ANIMAL INSIDE OUT is to illustrate the interconnectedness of all species when the covering is removed. From the outside, the diversity of life is evident by all of the different and unique life forms on Earth. Through revealing their, and our, internal structures the interconnectedness of life can be better understood. Multicellular organisms consist of body systems, some more complex than others.

As an example, this case can be made by comparing bird wings and primate skeletal structure in the forearms. Each of the organisms possesses a humerus (upper arm in primates), radius and ulna (both comprising the forearm in primates), carpals and metacarpals (primate wrist bones) and phalanges (primate fingers). The main difference between these organisms is the use of the structure and the size and number of certain bones.

Humans tend to identify the most with gorillas and chimpanzees when it comes to likeness. Certainly, there are more similarities in body structure than dissimilarities, such as similar muscle groups, an opposable thumb on the hand to allow for grasping and handling objects, as well as common reproductive strategies. There are specific structures on humans that allow for walking upright on two feet all of the time that are unique to humans and are either not found in apes or are slightly modified. (Summers)
3. How do animals use specific adaptations to survive in their environments?

*ANIMAL INSIDE OUT* highlights the unique adaptations in animal groups that allow for survival and proliferation of their species. For example, sharks have adapted to their environment so well they have been present in some form for over 300 million years. Sharks belong to the most numerous and diverse classification of vertebrates on Earth, fish, and are categorized as cartilaginous fish. This means their skeletal structure is made of cartilage not bone, as with other fish. Sharks have extremely well developed sensory organs; this enables them to be considered apex predators in Earth’s oceans.

The reindeer is another example of an animal that has highly developed adaptations for the extremely cold environment it lives in. Reindeer hair is hollow like a straw. This adaptation allows the reindeer to float when swimming. The hairs is also designed to trap air inside separate hair and serves as a good insulator. Heat is trapped close to the body by a long, thick winter coat. The reindeer also has the ability to cool down its limbs in the winter in order to conserve body heat. The blood vessels constrict, restricting the flow of warm blood to the limbs and saving heat and energy for the muscles higher up in the animals body since the reindeer lower legs are primarily tendons and ligaments. When the outside temperature warms to above 0°F the blood vessels open and allow warm blood to flow to the legs again. (Dieterich, Morton and Station, pg. 15)

4. Why is understanding anatomy critical to discovering more about the evolution of living organisms and the natural world?

The nature of science is an effort to understand, or better understand, the natural world and how it works. Science asks the questions: What is there? How does it work? How did it come to be this way? The homology of past and present living organisms is revealed by studying the anatomy and cellular similarities and differences of organisms. There are 500 genes that are common to all species. This commonality provides strong evidence that all living things descended from the same ancestor. Comparative anatomy brings to light the concealed similarities to establish a relationship between different species of living organisms. Developmental biology allows scientists to study the embryological development of living things. Developing embryos provide evidence for common ancestry. This provides clues to the evolution of present day organisms. The applicability of evolution in science allows for progress in medical science, agriculture and conservation.
FAQ

What is the purpose of the exhibition?
The purpose of ANIMAL INSIDE OUT is to inspire a deeper appreciation and respect for the animal world. The exhibition will allow visitors the unique opportunity to explore the intricate biology and physiology of some of the world’s most spectacular creatures, using the amazing science of Plastination. A visit to ANIMAL INSIDE OUT will go beyond what is seen in zoos, aquariums and animal parks. Visitors will be better able to understand the inner workings of animals and compare them to human anatomy, resulting in a new understanding of the amazing beauty of both animals and humans.

Is this exhibition appropriate for children?
ANIMAL INSIDE OUT was designed for visitors of all ages to better understand animal anatomy. Children and adults will be delighted when they discover curiosities about animals – like the reason why reindeers can navigate icy ground, what the giraffe’s tongue is capable of, and why bulls have such strength. This exhibition provides an opportunity to see and learn about animals like never before.

What is Plastination?
Invented by scientist and anatomist Dr. Gunther von Hagens in 1977, Plastination is the groundbreaking method of halting decomposition to preserve anatomical specimens for scientific and medical education. Plastination is the process of extracting all bodily fluids and soluble fat from specimens, replacing them through vacuum-forced impregnation with reactive resins and elastomers, and then curing them with light, heat or certain gases, which give the specimens rigidity and permanence. For more information about Dr. von Hagens, the inventor of the Plastination technique and creator of the BODY WORLDS exhibitions and ANIMAL INSIDE OUT, please visit www.bodyworlds.com.

Where did the animals on display come from?
ANIMAL INSIDE OUT, a Body Worlds Production is made possible with cooperation between various university veterinary programs, zoos and animal groups. No animal was harmed or killed for this exhibition.
Among the animals in the exhibition, are human specimens, originating from the Institute for Plastination’s body donation program. The generosity of these individual donors has made it possible to present human specimens in this and all of the BODY WORLDS exhibitions.
Dr. Gunther von Hagens and Dr. Angelina Whalley, creators of ANIMAL INSIDE OUT, are honored to be able to conserve and present these biological wonders of nature for anatomical study. They hope that this exhibition will show visitors the similarities between humans and animals, leading to a greater respect and appreciation for all animals.

Where have the animal plastinates been shown before?
More than 100 Animal plastinates are being shown for the first time, together in this unique exhibition. The majority of the specimens had never been seen before. Some animal plastinates had been previously incorporated in BODY WORLDS The Original exhibitions. The popularity of these animal specimens prompted curator, Dr. Angelina Whalley, to compose ANIMAL INSIDE OUT, a BODY WORLDS Production.

What will be the subsequent exhibition locations?
ANIMAL INSIDE OUT will be on display in North America beginning March 14, 2013. This exhibition will have its North American debut at the Museum of Science and Industry, Chicago (MSI). The exhibition will continue touring zoos, museums and science centers. Please check the Exhibition tab for updates on future locations.

How long will I need to fully appreciate the exhibition?
This comprehensive exhibition includes detailed information on the specimens shown and further explorations of the animal kingdom. Average duration of a visit to ANIMAL INSIDE OUT is one hour. Guests are welcome to remain in the exhibition as long as they wish, within opening hours.

Can I take photographs or film in the exhibitions?
Taking photographs and filming, including the use of mobile phone cameras, is not allowed in the ANIMAL INSIDE OUT exhibition. Exceptions are made for accredited members of the media.