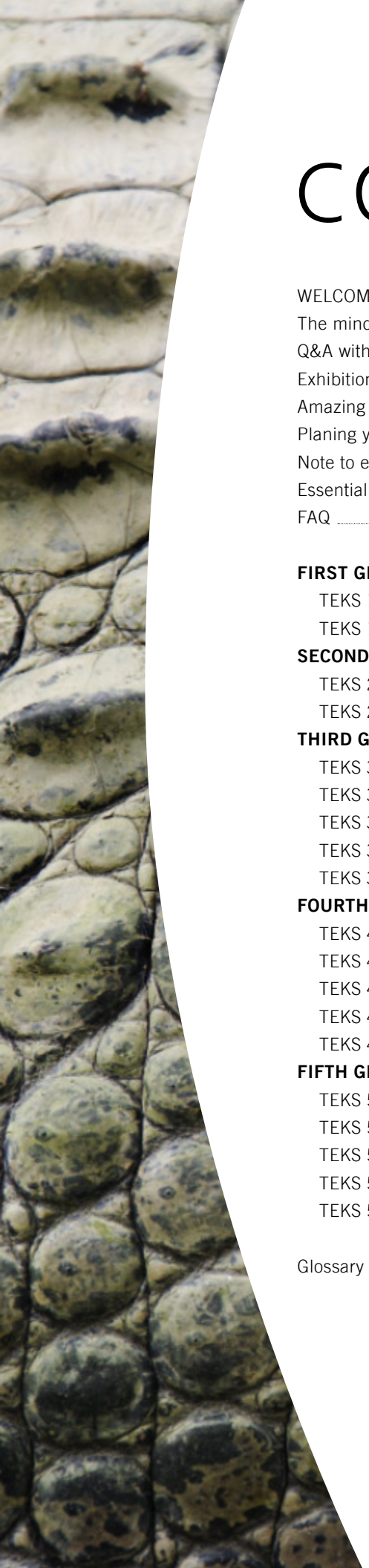
ANIMAL INSIDE OUT

A BODY WORLDS Production

Per[ ]t
Museum of Nature and Science

EDUCATOR'S **GUIDE**

Grades 1 – 5



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WELCOME

A LETTER FROM ANIMAL INSIDE OUT

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 Deisgner
ANIMAL INSIDE OUT, a Body Worlds Production

THE MIND BEHIND **THE EXHIBITION**

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

Q&A WITH KIDS

Children Visiting ANIMAL INSIDE OUT—Interview with Dr. Gunther von Hagens' Creator of BODY WORLDS & Inventor of Plastination

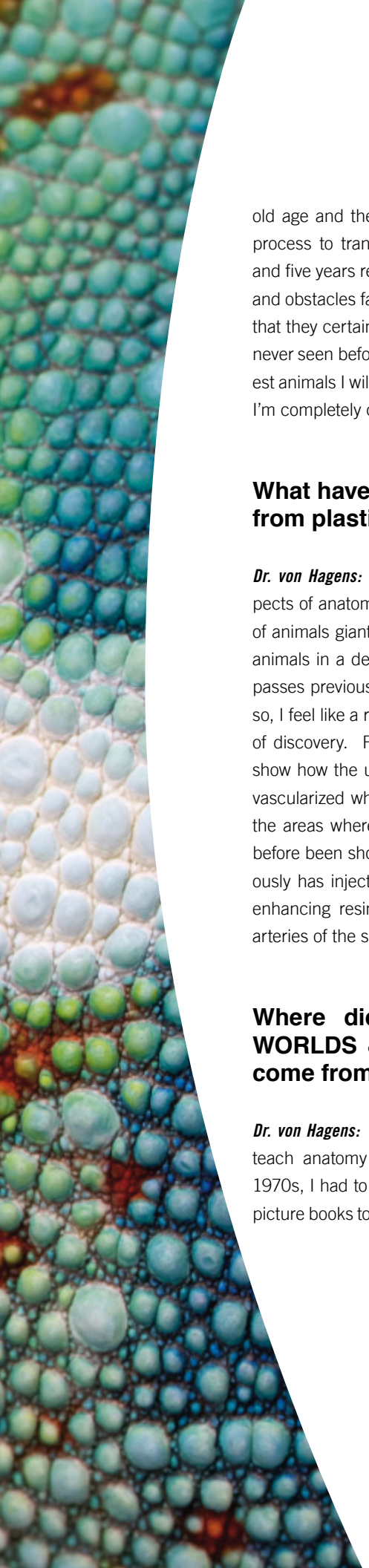
Were you ever scared to work with dead animals and bodies?

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: 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.

Ostrich

AMAZING **FACTS**

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.

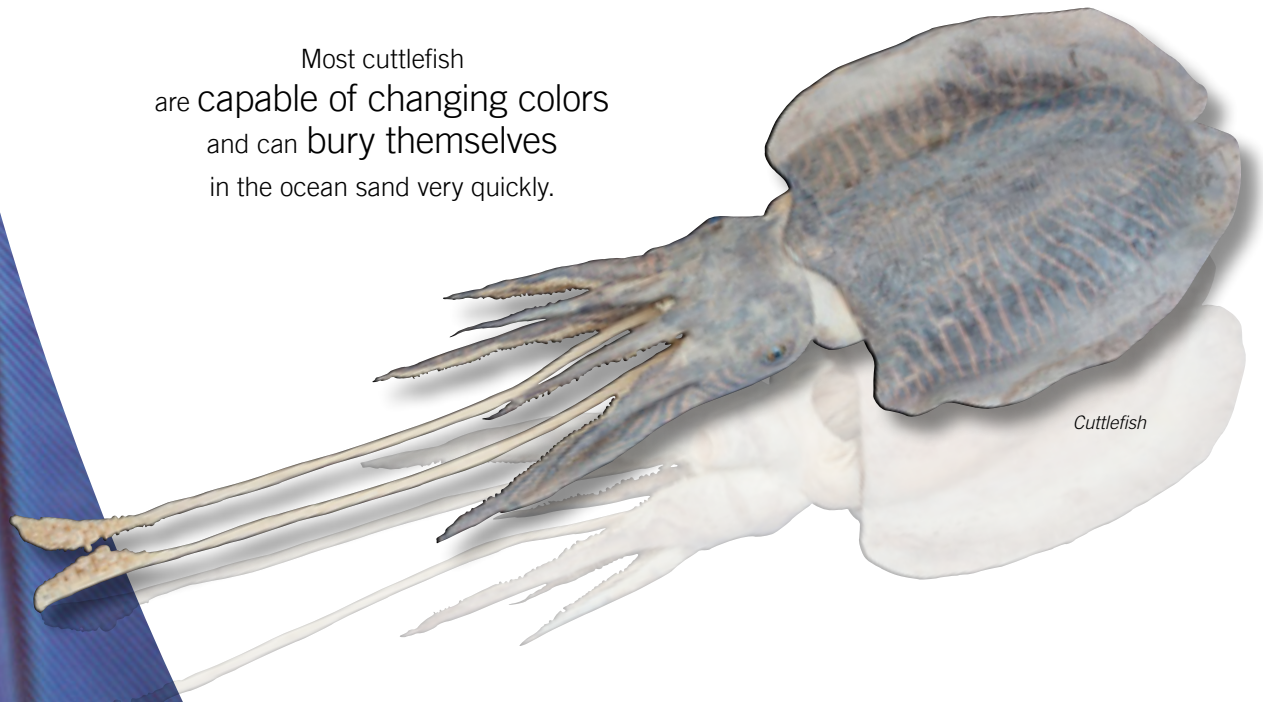
Sharks
have been swimming the seas
for 400 million years—
longer than dinosaurs
have been walking the earth.

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.



Cuttlefish

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.

PLANING YOUR VISIT

CHAPERONE RESPONSIBILITIES

Thank you for volunteering to be a chaperone on your school's visit to ANIMAL INSIDE OUT at the Perot Museum of Nature and Science. 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:

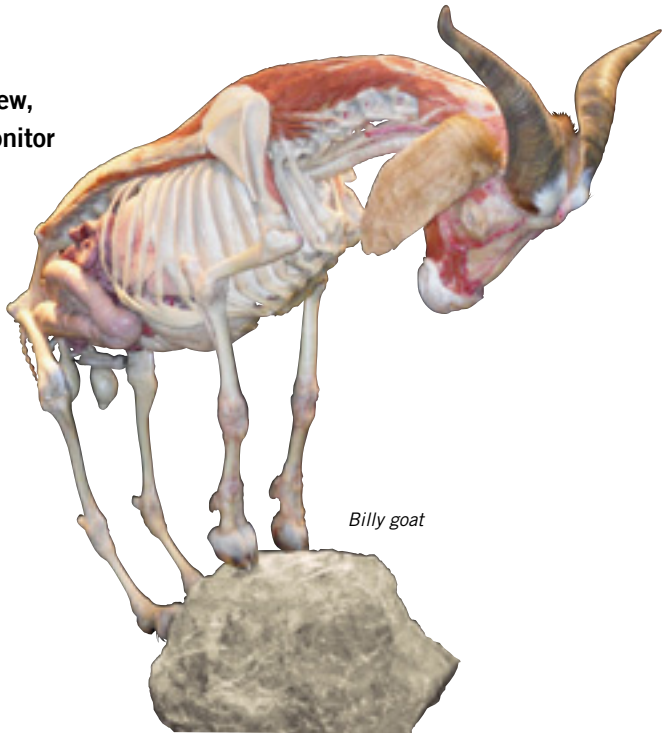
- All adults accompanying a school group to the ANIMAL INSIDE OUT exhibit are responsible for students behavior and experience (this includes teachers).

- Please ensure that you and your group of students (7 students or less per chaperone) 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:

    - 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 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.



Billy goat

NOTE TO EDUCATORS

STRATEGIES TO HELP THE EDUCATOR COME PREPARED

The Perot Museum 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.

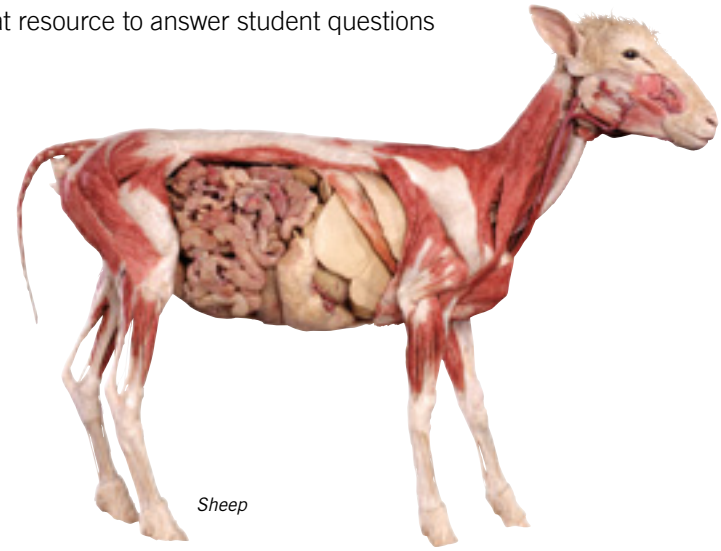
- Educator materials are available for pre/post student
  learning that correlate with the exhibit and Texas Essential Knowledge and Skills for Science.
  Many of the lessons have a component that can be completed while viewing the exhibit.

- Review student behavior expectations with your students prior to your visit:

  - 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 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 is a great resource to answer student questions
  about the plastination process.



Sheep

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 Perot Museum has developed educator materials that correlate with the exhibit. These lessons are aligned with the Texas Essential Knowledge of Skills for Science.

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

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

Bactrian camel

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)

Octopus

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 reindeers 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.

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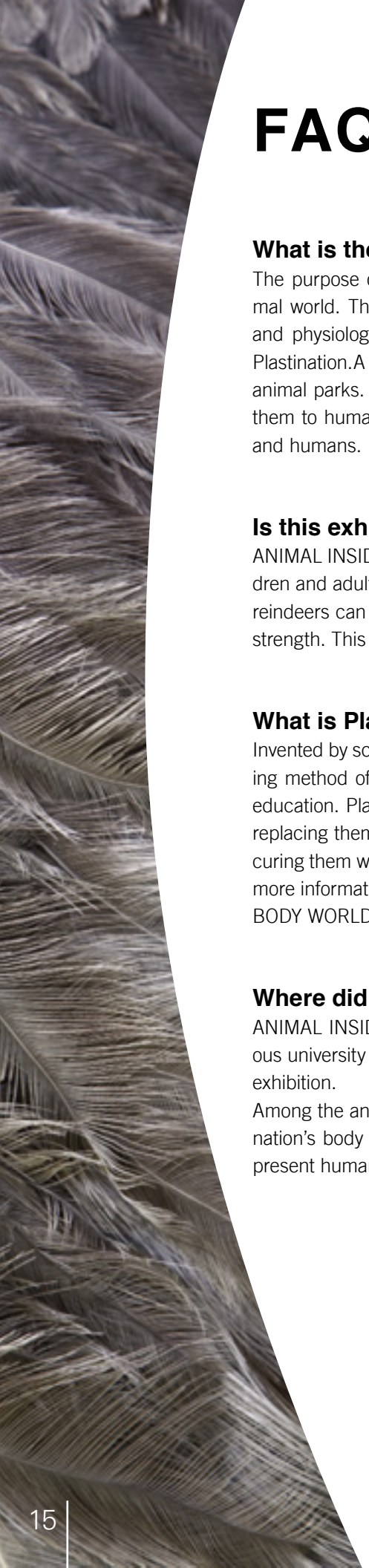

FAQ

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.

Cross-section of a crocodile

Discovering life
through structure and function

TEKS 1.10A Investigate how the external characteristics of an animal are related to where it lives, how it moves and what it eats.

ESSENTIAL QUESTION

How do animals use different body structures for survival?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism

Discovering life
through structure and function

As you walk through the ANIMAL INSIDE OUT exhibit, observe the various organisms. Note their various **structures** and how they **help them to function in their environment**.

Record the information in the table below

NAME OF ORGANISM	STRUCTURE	FUNCTION

Based on your observations, how do the **structures** of the different organisms you observed **help them to survive in their environments?**

Do you think these organisms would be able to survive if they were placed in a different type of ecosystem or environment?

Grade 1

Movement and environment

TEKS 1.10A Investigate how the external characteristics of an animal are related to where it lives, how it moves and what it eats.

ESSENTIAL QUESTION

Does the environment the animal live in influence an animal's adaptations?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

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ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism

Movement and function

Choose 4 different animals to **compare** their body **structures**

ANIMAL	**DRAW A PICTURE** of the structure the animal uses to move (4 legs, 2 legs, fins, wings?)	**ENVIRONMENT** the animal lives in
SHARK		OCEAN
OSTRICH		
HUMAN		
REINDEER		LAND

How does the way an animal **moves (locomotion)** benefit the animal in **survival?**

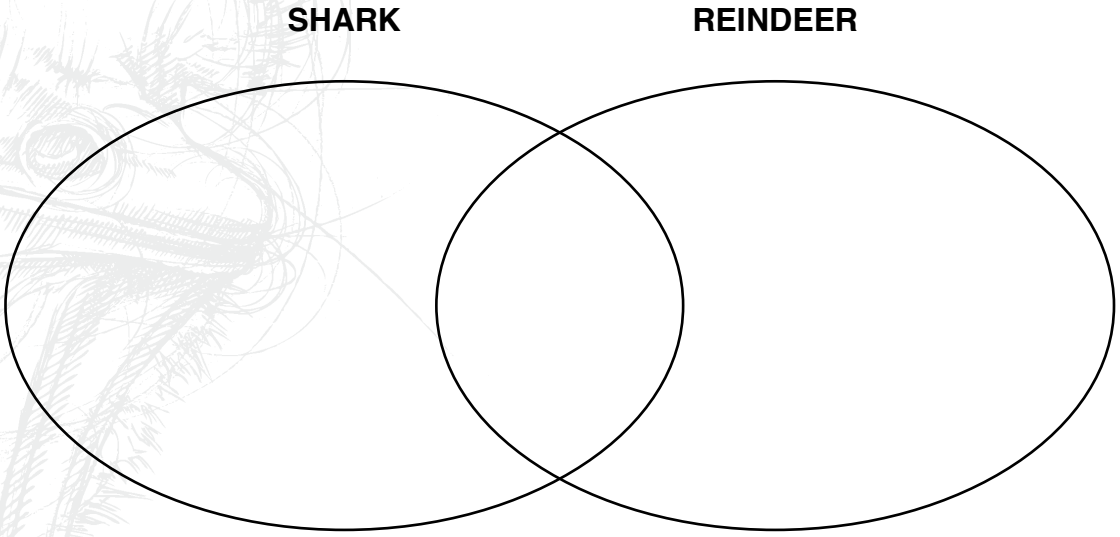
Does the **environment** the animal lives in influence the animal's **adaptation** for movement?

Grade 1

Movement and function

Compare/Contrast similarities and differences between the *shark and reindeer* (living/non-living, vertebrate/invertebrate, environment they live in, how they move…)

(Fill in the blank spaces)



What did you learn from doing this activity at the museum?

TRY THIS OUT
Based on the information provided in the exhibit, what type of adaptations does the shark have that help it survive in its environment?

Grade 1

Discovering life
through structure and function

TEKS 2.10A Observe, record and compare how the physical characteristics and behaviors of animals help them meet their basic needs such as fins help fish move and balance in the water.

ESSENTIAL QUESTION

How do animals use different body structures for survival?

LESSON OBJECTIVE

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MATERIALS

Per Student: Museum-School Connection page

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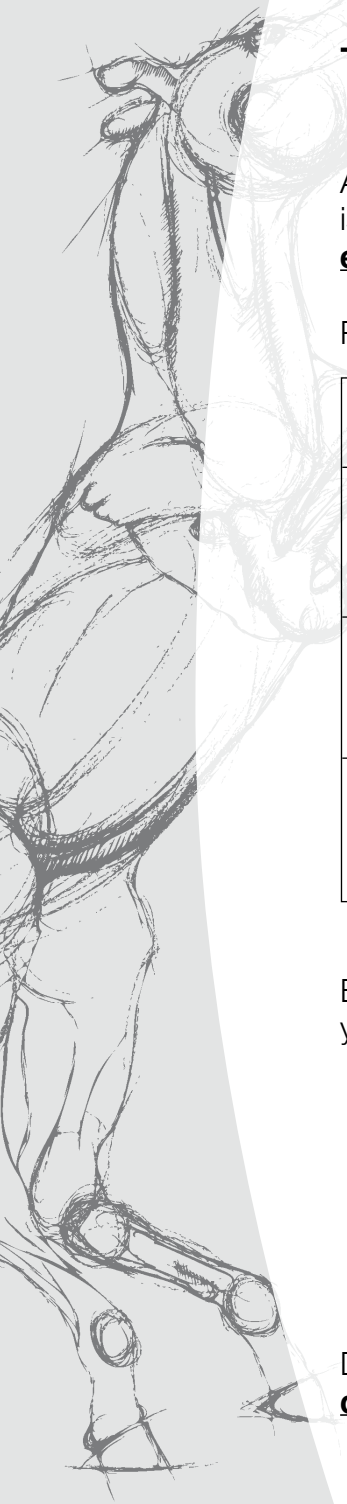
ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism



Discovering life
through structure and function

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Record the information in the table below

NAME OF ORGANISM	STRUCTURE	FUNCTION

Based on your observations, how do the **structures** of the different organisms you observed **help them to survive in their environments**?

Do you think these organisms would be able to **survive** if they were placed in a **different type of ecosystem or environment**?

Grade 2

Movement and environment

TEKS 2.10A Observe, record and compare how the physical characteristics and behaviors of animals help them meet their basic needs such as fins help fish move and balance in the water.

ESSENTIAL QUESTION

Does the environment the animal live in influence an animal's adaptations?

LESSON OBJECTIVE

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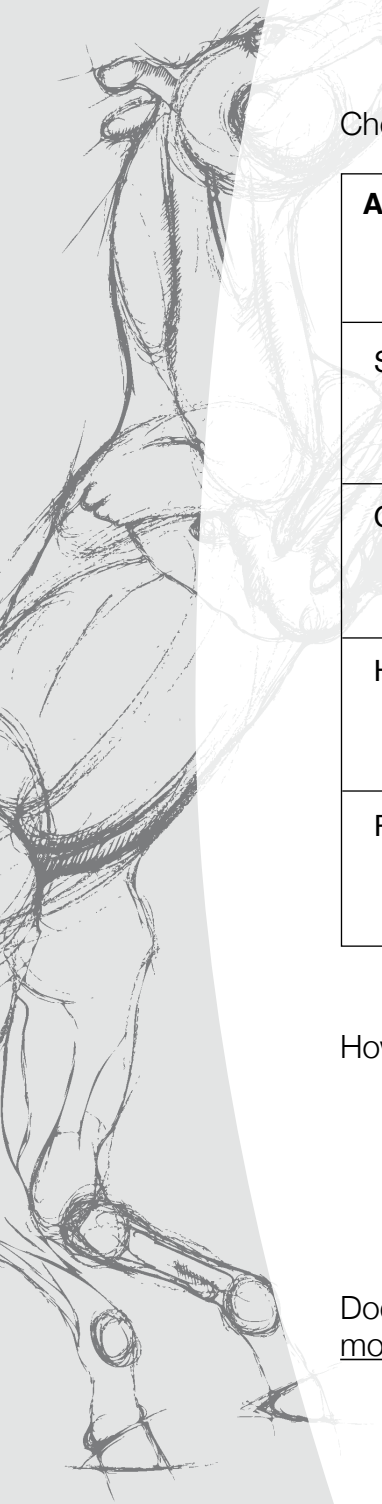
ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism

Movement and function



Choose 4 different animals to **compare** their body **structures**

ANIMAL	**DRAW A PICTURE** of the structure the animal uses to move (4 legs, 2 legs, fins, wings?)	**ENVIRONMENT** the animal lives in
SHARK		OCEAN
OSTRICH		
HUMAN		
REINDEER		LAND

How does the way an animal **moves (locomotion)** *benefit* the animal in **survival**?

Does the **environment** the animal lives in influence the animal's **adaptation** for movement?

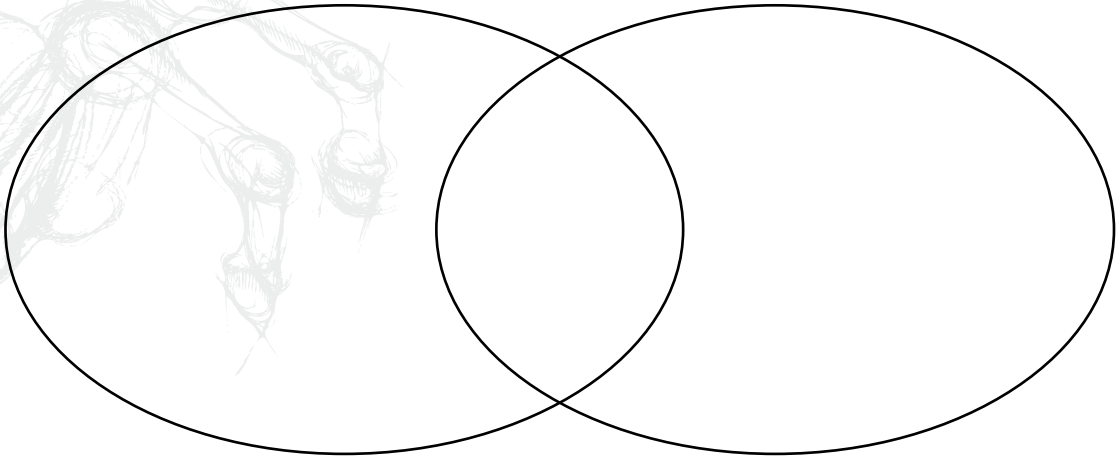
Grade 2

Movement and function

Compare/Contrast similarities and differences between the *shark and reindeer* (living/non-living, vertebrate/invertebrate, environment they live in, how they move…)

(Fill in the blank spaces)

SHARK **REINDEER**



What did you learn from doing this activity at the museum?

TRY THIS OUT
Based on the information provided in the exhibit, what type of adaptations does the shark have that help it survive in its environment?

Grade 2

Adaptations

TEKS 3.10 Explore how structures and functions of plants and animals allow them to survive in a particular environment

ESSENTIAL QUESTION

How do animals use different adaptations for survival?

LESSON OBJECTIVE

This is a multi-station lesson over adaptations. The stations cover reading comprehension, vocabulary matching and compare/contrast. The student will analyze how animals use camouflage, migration, hibernation and adaptions for survival.

MATERIALS

Per Group	Adapting To Survive reading comprehension passage, animal photos and animal description, animal photos for compare/contrast Venn diagram
Per Student	Science journal, reading comprehension questions, vocabulary cards

DIRECTIONS

Prepare stations ahead of time.

ACADEMIC VOCABULARY

Adapt, adaptations, migration, hibernation, camouflage, survival, survive, physical adaptation, behavior adaptation

POSSIBLE QUESTIONS

1. Can you think of ways that we adapt to certain environments?
2. Do animals adapt quickly to changes in the environment or does it take time for the animals to change for survival?

TECHNOLOGY INTEGRATION AND WEBSITES

http://www.ecokids.ca/pub/eco_info/topics/climate/adaptations/
http://www.planet-science.com/categories/under-11s/games/2010/09/mission-adaptation.aspx
http://teacher.scholastic.com/activities/explorations/adaptation/

Adaptations

STATION ACTIVITIES

1. Reading comprehension- “Adapting To Survive” reading passage and questions. (laminate reading passage)
2. Animal Adaptation Sort and T-chart. (laminate animal photos and descriptions, cut apart for matching).
3. Compare/Contrast Adaptation as behavioral or physical (laminate animal photos).
4. Vocabulary matching (laminate, cut apart for matching).

STATION 1

- Read the passage “Adapting to Survive”.
- Answer the **5 questions** that go along with the reading passage.

STATION 2

- Draw t-chart in your journal. Title on the left column should be ***“animal”***; title on the right column should be ***“adaptation”***.
- Match the animal pictures with the correct description.
- Fill out your t-chart with the name of the animal in the left column and the adaptations of the animal in the right column.
- Determine if the **adaptation** is **physical** (the physical appearance of the animal is adapted for survival in its environment) or **behavior** (the action of the animal for survival).

Adaptations

STATION 3

- Look at the pictures of the Monarch Butterfly, Bull Frog and Python.
- Make a 3 circle Venn diagram.
- Compare and contrast each animal's adaptations in the Venn diagram.

STATION 4

- Cut the vocabulary words and definitions apart.
- Match the vocabulary word with the correct definition.
- Glue the vocabulary word matched with the correct definition into your science journal.
- Vocabulary words: **Adaptation, Migration, Hibernation, Camouflage**

Adapting to survive

Living things adapt to their environment so they can **survive**. An organism **adapts** when it develops a **behavior** that makes it more likely to **survive**. It can also adapt by forming a physical characteristic or body part that helps it survive.

In a forest biome, some trees grow taller than the other plants around them. This lets them reach the sunlight. Growing taller is an adaptation that helps trees survive. Shorter plants have adapted with their behavior. They have learned to live in the shade with less sunlight.

Animals in the forest have a wide variety of adaptations. Monkeys have long tails. They can use them almost like another hand. This helps them swing quickly through the tops of trees. They can even do this while holding their babies or gathering good. Giraffes need to reach leaves at the tops of tall trees. Having a long neck is an adaptation that allows them to do this.

Some animals' adaptations prevent other animals from wanting to eat them. A skunk's horrible smell makes larger animals choose something else to eat. Even plants sometimes protect themselves in this way. Roses and acacia trees both have dangerous thorns. The thorns prevent animals from eating their leaves.

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

_____

_____

2. What is one animal adaptation you read about in the passage?

_____

_____

3. Is the animal adaptation you chose a physical or behavioral adaptation?

_____

_____

4. What is one plant adaptation you read about in the passage?

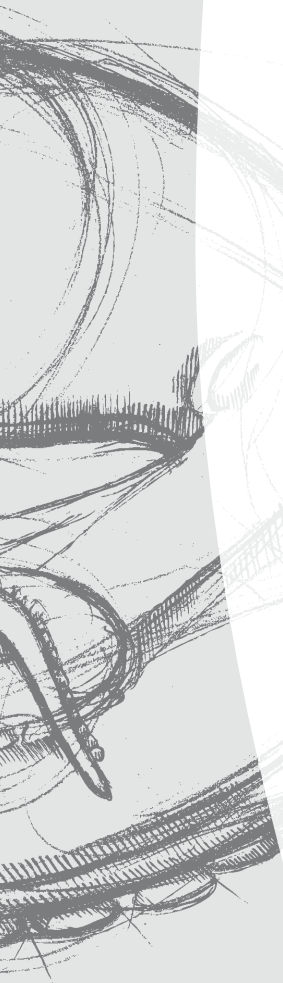
_____

_____

5. Is the plant adaptation you chose a physical or behavioral adaptation?

_____

_____



ANSWER KEY

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

By changing its behavior or its physical characteristics

2. What is one animal adaptation you read about in the passage?

A monkey's tail or a giraffe's neck or a skunk's smell

3. Is the animal adaptation you chose a physical or behavioral adaptation?

Trees grow tall or short plants learn to live with less sunlight or roses and acacia trees grow thorns

4. What is one plant adaptation you read about in the passage?

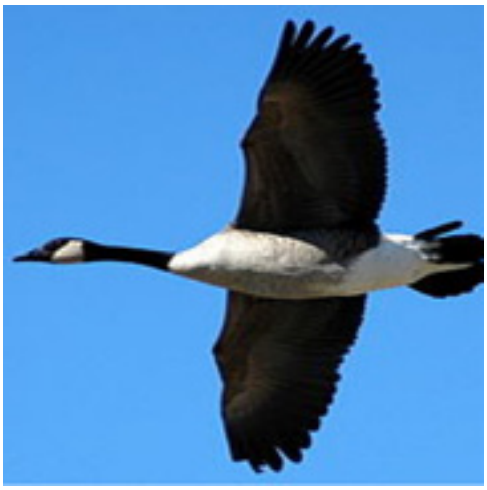
Trees-physical; short plants- behavioral; roses and acacia trees- physical

5. Is the plant adaptation you chose a physical or behavioral adaptation?

Student's choice

Station 2

Animal photos & description cards



Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

My under fur is very dense and traps a layer of air next to the skin for insulation. **To survive during the winter I eat the inner bark of trees.**	**I travel thousands of miles to migrate. Millions of us migrate together entering the Gulf of Alaska from nearby streams.** **Scientists are not exactly sure why we migrate.**
I make a den by digging beneath the roots of a large tree, and chew up roots and throw out rocks and dirt that block the way. **I survive the winter months by eating enough food in order to store huge amounts of fat on my body.** **I will enter my den late October for the next 5-6 months.**	**I live on land and in the water.** **My coat is thick and water repellant.** **My webbed feet make me a very good swimmer.**
My color allows me to blend in perfectly with leaves on the tree. **I have relatives that look like walking sticks, tree bark or withering flowers.**	**I live in warm climates.** **My skin color can change to blend in with the surroundings or for communication.** **I have a very long, sticky tongue.** **My eyes move independently of each other.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

I can stand up to 20 feet tall. **My long neck allows me reach trees to eat from that other animals cannot reach.** **Even though my neck is very long, I have the same number of neck vertebrae as most mammals, 7.**	**I migrate south for the winter but live in the northern parts of Canada and Alaska in the summer.** **We are known for flying in a V- shape during our migration and you can hear our calls as we fly over.**
I am a mammal but I have a protective plate of armor on my back. **Some of my relatives can roll into a ball for protection.** **I have a very long front claw for digging up insects to eat.** **I have a small mouth since I only eat insects.**	**I am covered in spines. These not only protect me from herbivores, but help me conserve water.** **I am able to survive in very hot and dry climates.** **My outer layer is thick and waxy, this also helps to conserve water.**
You can find me living in wooded areas of most of the United States. **My color allows me to blend in with trees perfectly.** **I usually hunt at dawn or dusk.**	**I usually live in tall trees or high growing vegetation.** **I am able to blend in perfectly with my environment.** **My feet have small discs that help me hold on to plant and tree limbs.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 3

Compare/Contrast Adaptations

	**Terrestrial frogs- frogs that live primarily on land- dig deep burrows in the soil below the frost line to hibernate in for the winter.** **Many frogs will actually freeze during the winter months and look frozen and dead. Frogs have a high concentration of glucose in their organs that prevents the organs from freezing. When it begins to warm up again, the frozen areas of the frog thaw and the heart and lungs resume activity.**
	**Monarch butterflies migrate to Mexico each year in order to survive. They cannot live in cold temperatures.** **Monarchs fly up to 2,500 miles to a warmer climate. They are the only insect that can fly that far.**
	**Pythons camouflage on their back allows them to blend in perfectly with leaf litter on the forest floor.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 4

Vocabulary Cards

Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.
Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Discovering life
through structure and function

TEKS 3.10A Explore how structures and functions of plants and animals allow them to survive in a particular environment.

ESSENTIAL QUESTION

How do animals use different body structures for survival?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

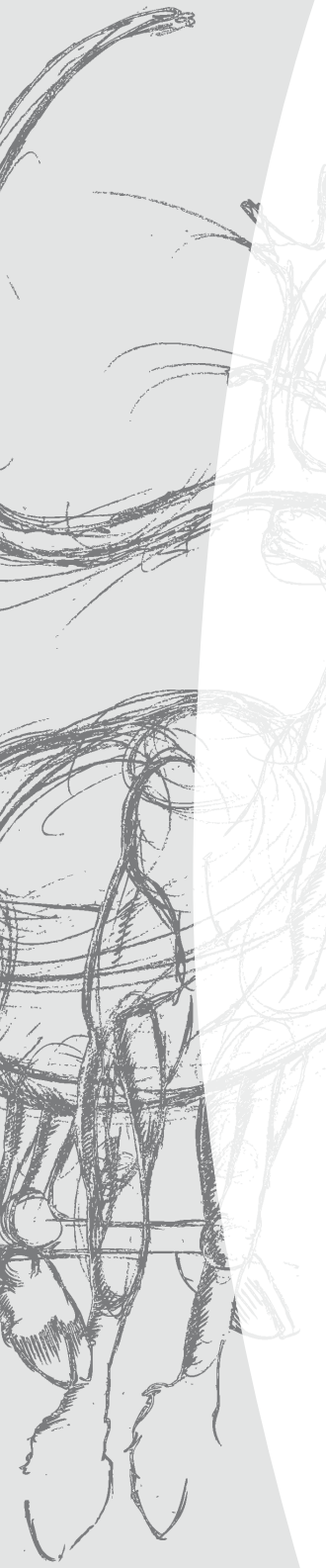
Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism



Discovering life
through structure and function

As you walk through the ANIMAL INSIDE OUT exhibit, observe the various organisms. Note their various **structures** and how they **help them to function in their environment.**

Record the information in the table below

NAME OF ORGANISM	STRUCTURE	FUNCTION

Based on your observations, how do the **structures** of the different organisms you observed **help them to survive in their environments**?

Do you think these organisms would be able to **survive** if they were placed in a **different type of ecosystem or environment**?

Grade 3

Movement and environment

TEKS 3.10A Explore how structures and functions of plants and animals allow them to survive in a particular environment

ESSENTIAL QUESTION

Does the environment the animal live in influence an animal's adaptations?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example fins on a shark or teeth on a herbivore.

MATERIALS

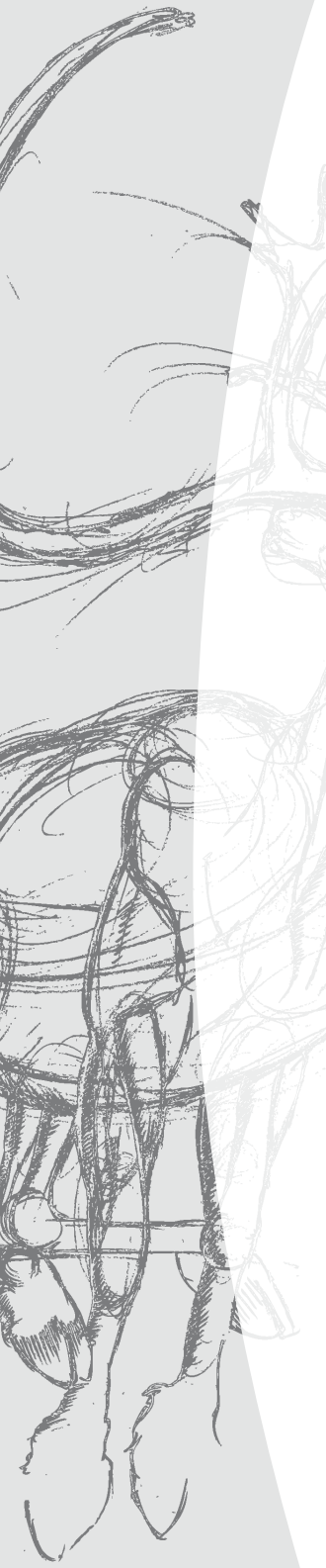
Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism



Movement and function

Choose 4 different animals to **compare** their body **structures**

ANIMAL	**DRAW A PICTURE** of the structure the animal uses to move (4 legs, 2 legs, fins, wings?)	**ENVIRONMENT** the animal lives in
SHARK		OCEAN
OSTRICH		
HUMAN		
REINDEER		

How does the way an animal **moves (locomotion)** *benefit* the animal in **survival**?

Does the **environment** the animal lives in influence the animal's **adaptation** for movement?

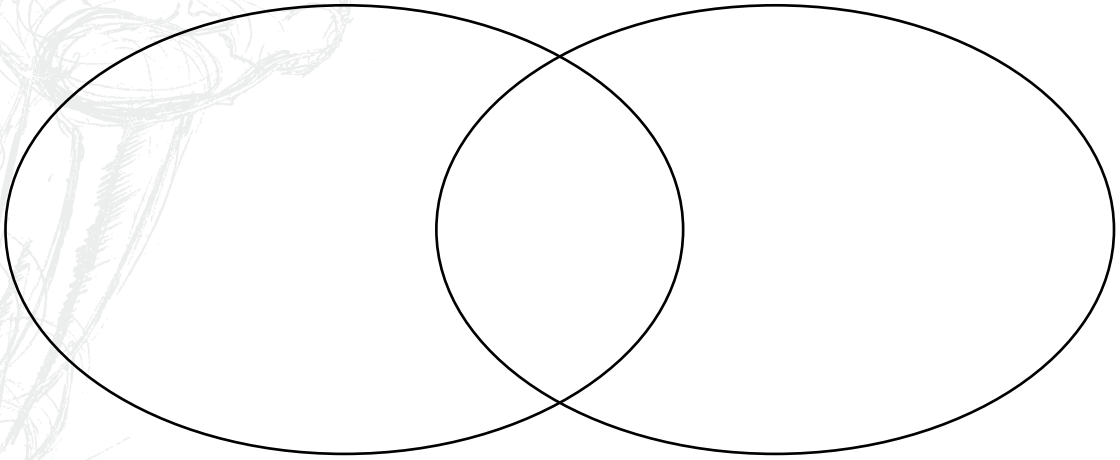
Grade 3

Movement and function

Compare/Contrast similarities and differences between the *shark and reindeer* (living/non-living, vertebrate/invertebrate, environment they live in, how they move…)

(Fill in the blank spaces)

SHARK **REINDEER**



What did you learn from doing this activity at the museum?

TRY THIS OUT
Based on the information provided in the exhibit, what type of adaptations does the shark have that help it survive in its environment?

Grade 3

Real life adaptations

TEKS 3.10A Explore how structures and functions of plants and animals allow them to survive in a particular environment.

☒ Readiness Standard ☐ Supporting Standard
ELPS

ESSENTIAL QUESTION

What animal **adaptations** could we use to make things easier for us?

LESSON OBJECTIVE

The student will explore how we use objects that mimic beneficial **adaptations** on animals. Such as swim fins while swimming. The student will make the connection that these adaptations enable animals to **survive** and thrive in their **environments**.

LEARNING STYLE

☐ Spatial ☐ Auditory/Musical ☒ Linguistic ☐ Kinesthetic
☒ Logical ☐ Interpersonal ☐ Intrapersonal

MATERIALS

Per Group Pictures of various animal **adaptations** and objects humans use to mimic that specific **adaptation**.

DIRECTIONS

1. Pass out the animal cards and human adaptation cards to each group.
2. Instruct the student to match the human adaptation to the animal structure card.
3. Have the students work their partner and discuss how humans and animals use these adaptations.
4. Instruct the student to write a brief explanation about the structure, how the animal uses it and how humans have found a way to mimic the adaptation to their benefit.

ACADEMIC VOCABULARY

Adaptation, structure, mimic, beneficial, survival

Real life adaptations

POSSIBLE QUESTIONS

1. Would an animal with webbed feet, meant for swimming, be as efficient on land running as they are swimming?

2. Why do you think humans mimic these adaptations? Does it help us with certain actions?

3. Can you think of an animal adaptation you wish you had and why?

PROJECTS TO EXTEND LEARNING

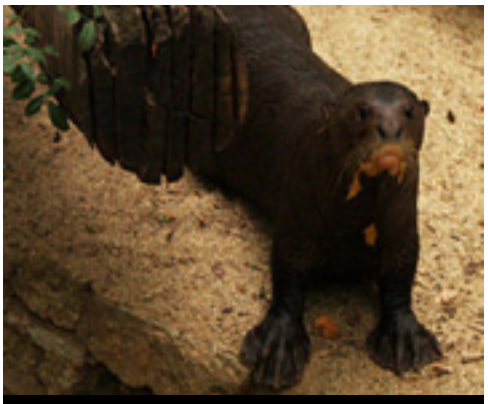
Students can create a new species of animal, selecting adaptations specific to certain animals, draw a picture of their animal and write a paragraph explaining the adaptations they chose.

Man wearing a coat

Killer whale

Bald eagle

Binoculars



Otter

Swim fins

Photos courtesy of Wikimedia Commons

Inherited or learned:
family tree of traits

TEKS 3.10B Explore that some characteristics of organisms are inherited such as the number of limbs on an animal or flower color and recognize that some behaviors are learned in response to living in a certain environment such as animals using tools to get food.

☐ Readiness Standard ☐ Supporting Standard
ELPS

ESSENTIAL QUESTION

Which of our **traits** did we **inherit** biologically from our parents and which ones did we **learn** by watching our parents?

LESSON OBJECTIVE

Students will make a "family tree" of physical traits that are **inherited genetically** and **learned traits**. They will include "branches" from other family members. This will allow the student to compare their own **traits** with other family members and determine which traits they are born with (**inherited**) and which **traits** they **learned** from their parents, siblings, friends.

LEARNING STYLE

☒ Spatial ☐ Auditory/Musical ☐ Linguistic ☐ Kinesthetic
☒ Logical ☒ Interpersonal ☒ Intrapersonal

MATERIALS

Per Student
- Large piece of paper or poster board
- Colored paper (one color per family member represented on the tree)
- Scissors
- Pen or markers
- Tape or glue

DIRECTIONS

1. Trace the right hand and left hand of each family member onto a piece of colored paper, including yours.
2. Cut out the handprints.
3. On the left handprint list a **physical trait that you inherited** on each finger (you should only end up with 5 listed traits) : *curly or straight hair, eye color, dimples or no dimples, freckles, free or attached earlobes, straight hairline or widow's peak (pointed hairline), left or right handed, ability to roll the tongue.*
4. On the right handprint list a **learned trait** on each finger (you should only end up with 5 traits): *writing, drawing, eating with a fork or spoon, favorite sport or hobby, favorite subject in school, riding a bike, able to read, favorite animal, favorite color, hit a baseball, catch a ball, able to swim….*
5. Do steps 3 & 4 for each of your family members.
6. Draw a tree trunk onto the large piece of paper or poster board.
7. Glue or tape your family's handprints above the trunk, they represent branches on the tree. Put the oldest person's handprint at the bottom of bottom of the tree, the youngest person's pair of hands should be at the top. The left handprints should be placed on the left side of the tree and the right handprints should be placed on the right side of the tree.
8. Students should then compare their **inherited and learned traits** with their other family members.

ACADEMIC VOCABULARY

Inherited, learned, traits, gene, genetics

POSSIBLE QUESTIONS

1. Do you share any **inherited or learned traits** with other family members?
2. Do you look identical to any other family member?
3. Did you watch someone to learn your **inherited traits**? What about your **learned traits**?

PROJECTS TO EXTEND LEARNING

Make a class graph of physical traits, analyze which traits are more commonly seen.

Adaptations

TEKS 4.10 Explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants.

ESSENTIAL QUESTION

How do animals use different adaptations for survival?

LESSON OBJECTIVE

This is a multi-station lesson over adaptations. The stations cover reading comprehension, vocabulary matching and compare/contrast. The student will analyze how animals use camouflage, migration, hibernation and adaptions for survival.

MATERIALS

Per Group	Adapting To Survive reading comprehension passage, animal photos and animal description, animal photos for compare/contrast Venn diagram
Per Student	Science journal, reading comprehension questions, vocabulary cards

DIRECTIONS

Prepare stations ahead of time.

ACADEMIC VOCABULARY

Adapt, adaptations, migration, hibernation, camouflage, survival, survive, physical adaptation, behavior adaptation

POSSIBLE QUESTIONS

1. Can you think of ways that we adapt to certain environments?
2. Do animals adapt quickly to changes in the environment or does it take time for the animals to change for survival?

TECHNOLOGY INTEGRATION AND WEBSITES

http://www.ecokids.ca/pub/eco_info/topics/climate/adaptations/
http://www.planet-science.com/categories/under-11s/games/2010/09/mission-adaptation.aspx
http://teacher.scholastic.com/activities/explorations/adaptation/

Adaptations

STATION ACTIVITIES

1. Reading comprehension- “Adapting To Survive” reading passage and questions. (laminate reading passage)
2. Animal Adaptation Sort and T-chart. (laminate animal photos and descriptions, cut apart for matching).
3. Compare/Contrast Adaptation as behavioral or physical (laminate animal photos).
4. Vocabulary matching (laminate, cut apart for matching).

STATION 1

- Read the passage “Adapting to Survive”.
- Answer the **5 questions** that go along with the reading passage.

STATION 2

- Draw t-chart in your journal. Title on the left column should be ***“animal”***; title on the right column should be ***“adaptation”***.
- Match the animal pictures with the correct description.
- Fill out your t-chart with the name of the animal in the left column and the adaptations of the animal in the right column.
- Determine if the **adaptation** is **physical** (the physical appearance of the animal is adapted for survival in its environment) or **behavior** (the action of the animal for survival).

Adaptations

STATION 3

- Look at the pictures of the Monarch Butterfly, Bull Frog and Python.
- Make a 3 circle Venn diagram.
- Compare and contrast each animal's adaptations in the Venn diagram.

STATION 4

- Cut the vocabulary words and definitions apart.
- Match the vocabulary word with the correct definition.
- Glue the vocabulary word matched with the correct definition into your science journal.
- Vocabulary words: **Adaptation, Migration, Hibernation, Camouflage**

Adapting to survive

Living things adapt to their environment so they can **survive**. An organism **adapts** when it develops a **behavior** that makes it more likely to **survive**. It can also adapt by forming a physical characteristic or body part that helps it survive.

In a forest biome, some trees grow taller than the other plants around them. This lets them reach the sunlight. Growing taller is an adaptation that helps trees survive. Shorter plants have adapted with their behavior. They have learned to live in the shade with less sunlight.

Animals in the forest have a wide variety of adaptations. Monkeys have long tails. They can use them almost like another hand. This helps them swing quickly through the tops of trees. They can even do this while holding their babies or gathering good. Giraffes need to reach leaves at the tops of tall trees. Having a long neck is an adaptation that allows them to do this.

Some animals' adaptations prevent other animals from wanting to eat them. A skunk's horrible smell makes larger animals choose something else to eat. Even plants sometimes protect themselves in this way. Roses and acacia trees both have dangerous thorns. The thorns prevent animals from eating their leaves.

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

_____

_____

2. What is one animal adaptation you read about in the passage?

_____

_____

3. Is the animal adaptation you chose a physical or behavioral adaptation?

_____

_____

4. What is one plant adaptation you read about in the passage?

_____

_____

5. Is the plant adaptation you chose a physical or behavioral adaptation?

_____

_____

ANSWER KEY

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

By changing its behavior or its physical characteristics

2. What is one animal adaptation you read about in the passage?

A monkey's tail or a giraffe's neck or a skunk's smell

3. Is the animal adaptation you chose a physical or behavioral adaptation?

Trees grow tall or short plants learn to live with less sunlight or roses and acacia trees grow thorns

4. What is one plant adaptation you read about in the passage?

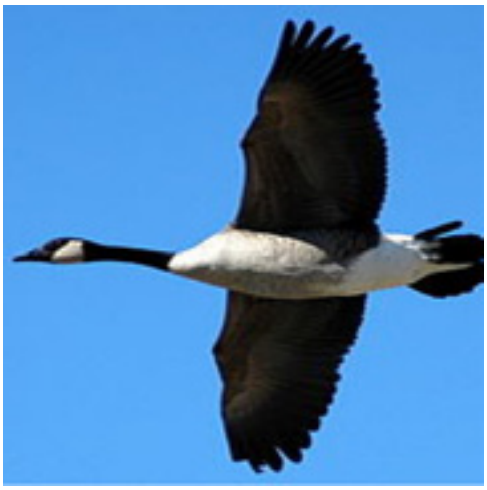
Trees-physical; short plants- behavioral; roses and acacia trees- physical

5. Is the plant adaptation you chose a physical or behavioral adaptation?

Student's choice

Station 2

Animal photos & description cards



Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

My under fur is very dense and traps a layer of air next to the skin for insulation. **To survive during the winter I eat the inner bark of trees.**	**I travel thousands of miles to migrate. Millions of us migrate together entering the Gulf of Alaska from nearby streams.** **Scientists are not exactly sure why we migrate.**
I make a den by digging beneath the roots of a large tree, and chew up roots and throw out rocks and dirt that block the way. **I survive the winter months by eating enough food in order to store huge amounts of fat on my body.** **I will enter my den late October for the next 5-6 months.**	**I live on land and in the water.** **My coat is thick and water repellant.** **My webbed feet make me a very good swimmer.**
My color allows me to blend in perfectly with leaves on the tree. **I have relatives that look like walking sticks, tree bark or withering flowers.**	**I live in warm climates.** **My skin color can change to blend in with the surroundings or for communication.** **I have a very long, sticky tongue.** **My eyes move independently of each other.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

I can stand up to 20 feet tall. **My long neck allows me reach trees to eat from that other animals cannot reach.** **Even though my neck is very long, I have the same number of neck vertebrae as most mammals, 7.**	**I migrate south for the winter but live in the northern parts of Canada and Alaska in the summer.** **We are known for flying in a V- shape during our migration and you can hear our calls as we fly over.**
I am a mammal but I have a protective plate of armor on my back. **Some of my relatives can roll into a ball for protection.** **I have a very long front claw for digging up insects to eat.** **I have a small mouth since I only eat insects.**	**I am covered in spines. These not only protect me from herbivores, but help me conserve water.** **I am able to survive in very hot and dry climates.** **My outer layer is thick and waxy, this also helps to conserve water.**
You can find me living in wooded areas of most of the United States. **My color allows me to blend in with trees perfectly.** **I usually hunt at dawn or dusk.**	**I usually live in tall trees or high growing vegetation.** **I am able to blend in perfectly with my environment.** **My feet have small discs that help me hold on to plant and tree limbs.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 3

Compare/contrast adaptations

	**Terrestrial frogs- frogs that live primarily on land- dig deep burrows in the soil below the frost line to hibernate in for the winter.** **Many frogs will actually freeze during the winter months and look frozen and dead. Frogs have a high concentration of glucose in their organs that prevents the organs from freezing. When it begins to warm up again, the frozen areas of the frog thaw and the heart and lungs resume activity.**
	**Monarch butterflies migrate to Mexico each year in order to survive. They cannot live in cold temperatures.** **Monarchs fly up to 2,500 miles to a warmer climate. They are the only insect that can fly that far.**
	**Pythons camouflage on their back allows them to blend in perfectly with leaf litter on the forest floor.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 4

Vocabulary cards

Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.
Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Blubber mania

4.10 A. Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

ESSENTIAL QUESTION

What **adaptation** do animals that live in extremely cold environments, such as seals and whales, possess that enables them to stay warm?

LESSON OBJECTIVE

The student will learn that these animals possess a layer of fat, called **blubber**. This layer of fat **insulates** the animals and conserves their body heat by slowing the transfer of energy, allowing them to survive in subzero environments without freezing. The students will work together as a group and record how long it took to feel the cold water through only a sandwich bag, representing skin, versus a bag with vegetable shortening, representing a layer of blubber.

MATERIALS

Per Group	Vegetable shortening, large zip-top bags (2 per group), large pail or bowl, ice, water, 1 thermometer, 1 timer, spoon or cup for vegetable shortening, tub to wash hands, soap, newspaper to cover table.
Per Student	1 sandwich bag

DIRECTIONS

1. Take 1 of the large zip-top bags (#1) and put about 1 cup of vegetable shortening in it.
2. Take the 2nd zip-top bag (#2) and turn it inside out.
3. Put #2 inside bag #1.
4. Zip the bags together so they lock.
5. Squish shortening around evenly between the bags.
6. Take a bowl or pail and put the water in it and add ice.
7. Place the thermometer into the water. Record the temperature of the water.
8. Put one hand inside the zipped-together bag and the other hand inside a sandwich bag.
9. Have student #1 place both hands into the water, one with just a sandwich bag and one in the zipped together bag with vegetable shortening in it, at the same time.
10. Have student #2 start the timer and record the time for when student #1 felt cold through just the sandwich bag and the time student #1 felt cold through the zipped bag.

ACADEMIC VOCABULARY

Adaptation, blubber, warm, cold, coat , insulation, heat

POSSIBLE QUESTIONS

1. Make a prediction, which hand do you think will feel warmer?
2. How does fat help some animals to keep warm?
3. Would these animals that have this adaptation to stay warm in extremely cold environments do well in a warmer environment? Why or why not?

TECHNOLOGY INTEGRATION AND WEBSITES

www.utmsi.utexas.edu/k12/adaptations.pdf

PROJECTS TO EXTEND LEARNING

Make a class graph illustrating data on the recorded times.

Put thermometers inside the different types of bags. Put 30 seconds on the timer. See if the thermometers read the same or differently after being inside the bags, inside the icy water, for 30 seconds.

Discovering life
through structure and function

4.10A Explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants.

ESSENTIAL QUESTION

How do animals use different body structures for survival?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Adaptation, structure, function, survival, survive, habitat, organism

Grade 4

Discovering life
through structure and function

As you walk through the ANIMAL INSIDE OUT exhibit, observe the various organisms. Note their various **structures** and how they **help them to function in their environment**.

Record the information in the table below

NAME OF ORGANISM	STRUCTURE	FUNCTION

Based on your observations, how do the **structures** of the different organisms you observed **help them to survive in their environments?**

Do you think these organisms would be able to survive if they were placed in a different type of ecosystem or environment?

Grade 4

Movement and environment

4.10A Explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants.

ESSENTIAL QUESTION

Does the environment the animal live in influence an animal's adaptations?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism

Movement and function

Choose 4 different animals to **compare** their body **structures**

ANIMAL	**DRAW A PICTURE** of the structure the animal uses to move (4 legs, 2 legs, fins, wings?)	**ENVIRONMENT** the animal lives in
SHARK		OCEAN
OSTRICH		
HUMAN		
REINDEER		

How does the way an animal **moves (locomotion)** benefit the animal in **survival?**

Does the **environment** the animal lives in influence the animal's **adaptation** for movement?

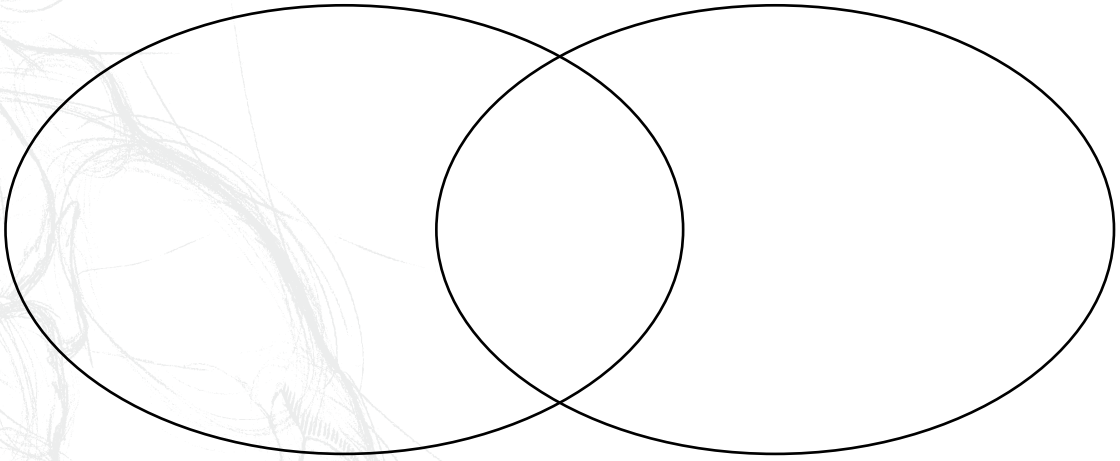
Grade 4

Movement and function

Compare/Contrast similarities and differences between the *shark and reindeer* (living/non-living, vertebrate/invertebrate, environment they live in, how they move…)

(Fill in the blank spaces)

SHARK **REINDEER**



What did you learn from doing this activity at the museum?

TRY THIS OUT
Based on the information provided in the exhibit, what type of adaptations does the shark have that help it survive in its environment?

Grade 4

Real life adaptations

TEKS 4.10A Explore how adaptations enable organisms to survive in their environment such as comparing birds' beaks and leaves on plants.

☒ Readiness Standard ☐ Supporting Standard
ELPS

ESSENTIAL QUESTION

What animal **adaptations** could we use to make things easier for us?

LESSON OBJECTIVE

The student will explore how we use objects that mimic beneficial **adaptations** on animals. Such as swim fins while swimming. The student will make the connection that these adaptations enable animals to **survive** and thrive in their **environments**.

LEARNING STYLE

☐ Spatial ☐ Auditory/Musical ☒ Linguistic ☐ Kinesthetic
☒ Logical ☐ Interpersonal ☐ Intrapersonal

MATERIALS

Per Group Pictures of various animal **adaptations** and objects humans use to mimic that specific **adaptation**.

DIRECTIONS

1. Pass out the animal cards and human adaptation cards to each group.
2. Instruct the student to match the human adaptation to the animal structure card.
3. Have the students work their partner and discuss how humans and animals use these adaptations.
4. Instruct the student to write a brief explanation about the structure, how the animal uses it and how humans have found a way to mimic the adaptation to their benefit.

ACADEMIC VOCABULARY

Adaptation, structure, mimic, beneficial, survival

Real life adaptations

POSSIBLE QUESTIONS

1. Would an animal with webbed feet, meant for swimming, be as efficient on land running as they are swimming?

2. Why do you think humans mimic these adaptations? Does it help us with certain actions?

3. Can you think of an animal adaptation you wish you had and why?

PROJECTS TO EXTEND LEARNING

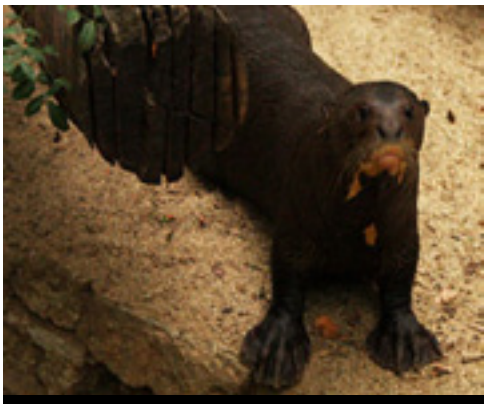
Students can create a new species of animal, selecting adaptations specific to certain animals, draw a picture of their animal and write a paragraph explaining the adaptations they chose.

Man wearing a coat

Killer whale

Bald eagle

Binoculars



Otter

Swim fins

Photos courtesy of Wikimedia Commons

Adaptations

TEKS 5.10 Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

ESSENTIAL QUESTION

How do animals use different adaptations for survival?

LESSON OBJECTIVE

This is a multi-station lesson over adaptations. The stations cover reading comprehension, vocabulary matching and compare/contrast. The student will analyze how animals use camouflage, migration, hibernation and adaptions for survival.

MATERIALS

Per Group	Adapting To Survive reading comprehension passage, animal photos and animal description, animal photos for compare/contrast Venn diagram
Per Student	Science journal, reading comprehension questions, vocabulary cards

DIRECTIONS

Prepare stations ahead of time.

ACADEMIC VOCABULARY

Adapt, adaptations, migration, hibernation, camouflage, survival, survive, physical adaptation, behavior adaptation

POSSIBLE QUESTIONS

1. Can you think of ways that we adapt to certain environments?
2. Do animals adapt quickly to changes in the environment or does it take time for the animals to change for survival?

TECHNOLOGY INTEGRATION AND WEBSITES

http://www.ecokids.ca/pub/eco_info/topics/climate/adaptations/
http://www.planet-science.com/categories/under-11s/games/2010/09/mission-adaptation.aspx
http://teacher.scholastic.com/activities/explorations/adaptation/

Adaptations

STATION ACTIVITIES

1. Reading comprehension- “Adapting To Survive” reading passage and questions. (laminate reading passage)
2. Animal Adaptation Sort and T-chart. (laminate animal photos and descriptions, cut apart for matching).
3. Compare/Contrast Adaptation as behavioral or physical (laminate animal photos).
4. Vocabulary matching (laminate, cut apart for matching).

STATION 1

- Read the passage “Adapting to Survive”.
- Answer the **5 questions** that go along with the reading passage.

STATION 2

- Draw t-chart in your journal. Title on the left column should be ***“animal”***; title on the right column should be ***“adaptation”***.
- Match the animal pictures with the correct description.
- Fill out your t-chart with the name of the animal in the left column and the adaptations of the animal in the right column.
- Determine if the **adaptation** is **physical** (the physical appearance of the animal is adapted for survival in its environment) or **behavior** (the action of the animal for survival).

Adaptations

STATION 3

- Look at the pictures of the Monarch Butterfly, Bull Frog and Python.
- Make a 3 circle Venn diagram.
- Compare and contrast each animal's adaptations in the Venn diagram.

STATION 4

- Cut the vocabulary words and definitions apart.
- Match the vocabulary word with the correct definition.
- Glue the vocabulary word matched with the correct definition into your science journal.
- Vocabulary words: **Adaptation, Migration, Hibernation, Camouflage**

Adapting to survive

Living things adapt to their environment so they can **survive**. An organism **adapts** when it develops a **behavior** that makes it more likely to **survive**. It can also adapt by forming a physical characteristic or body part that helps it survive.

In a forest biome, some trees grow taller than the other plants around them. This lets them reach the sunlight. Growing taller is an adaptation that helps trees survive. Shorter plants have adapted with their behavior. They have learned to live in the shade with less sunlight.

Animals in the forest have a wide variety of adaptations. Monkeys have long tails. They can use them almost like another hand. This helps them swing quickly through the tops of trees. They can even do this while holding their babies or gathering good. Giraffes need to reach leaves at the tops of tall trees. Having a long neck is an adaptation that allows them to do this.

Some animals' adaptations prevent other animals from wanting to eat them. A skunk's horrible smell makes larger animals choose something else to eat. Even plants sometimes protect themselves in this way. Roses and acacia trees both have dangerous thorns. The thorns prevent animals from eating their leaves.

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

_____

_____

2. What is one animal adaptation you read about in the passage?

_____

_____

3. Is the animal adaptation you chose a physical or behavioral adaptation?

_____

_____

4. What is one plant adaptation you read about in the passage?

_____

_____

5. Is the plant adaptation you chose a physical or behavioral adaptation?

_____

_____

ANSWER KEY

Name _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1. What are the two main ways that an organism adapts?

By changing its behavior or its physical characteristics

2. What is one animal adaptation you read about in the passage?

A monkey's tail or a giraffe's neck or a skunk's smell

3. Is the animal adaptation you chose a physical or behavioral adaptation?

Trees grow tall or short plants learn to live with less sunlight or roses and acacia trees grow thorns

4. What is one plant adaptation you read about in the passage?

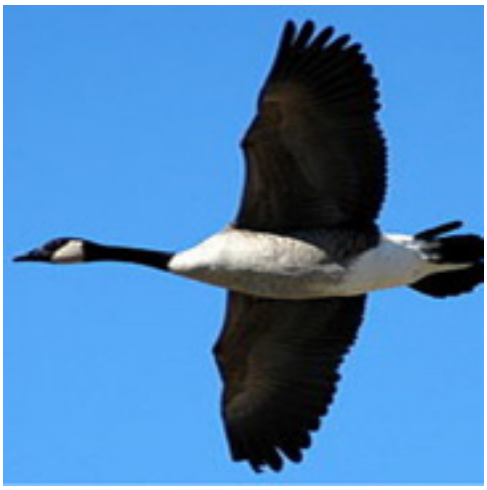
Trees-physical; short plants- behavioral; roses and acacia trees- physical

5. Is the plant adaptation you chose a physical or behavioral adaptation?

Student's choice

Station 2

Animal photos & description cards



Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

My under fur is very dense and traps a layer of air next to the skin for insulation. **To survive during the winter I eat the inner bark of trees.**	**I travel thousands of miles to migrate. Millions of us migrate together entering the Gulf of Alaska from nearby streams.** **Scientists are not exactly sure why we migrate.**
I make a den by digging beneath the roots of a large tree, and chew up roots and throw out rocks and dirt that block the way. **I survive the winter months by eating enough food in order to store huge amounts of fat on my body.** **I will enter my den late October for the next 5-6 months.**	**I live on land and in the water.** **My coat is thick and water repellant.** **My webbed feet make me a very good swimmer.**
My color allows me to blend in perfectly with leaves on the tree. **I have relatives that look like walking sticks, tree bark or withering flowers.**	**I live in warm climates.** **My skin color can change to blend in with the surroundings or for communication.** **I have a very long, sticky tongue.** **My eyes move independently of each other.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 2

Animal photos & description cards

I can stand up to 20 feet tall. **My long neck allows me reach trees to eat from that other animals cannot reach.** **Even though my neck is very long, I have the same number of neck vertebrae as most mammals, 7.**	**I migrate south for the winter but live in the northern parts of Canada and Alaska in the summer.** **We are known for flying in a V- shape during our migration and you can hear our calls as we fly over.**
I am a mammal but I have a protective plate of armor on my back. **Some of my relatives can roll into a ball for protection.** **I have a very long front claw for digging up insects to eat.** **I have a small mouth since I only eat insects.**	**I am covered in spines. These not only protect me from herbivores, but help me conserve water.** **I am able to survive in very hot and dry climates.** **My outer layer is thick and waxy, this also helps to conserve water.**
You can find me living in wooded areas of most of the United States. **My color allows me to blend in with trees perfectly.** **I usually hunt at dawn or dusk.**	**I usually live in tall trees or high growing vegetation.** **I am able to blend in perfectly with my environment.** **My feet have small discs that help me hold on to plant and tree limbs.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 3

Compare/contrast adaptations

	**Terrestrial frogs- frogs that live primarily on land- dig deep burrows in the soil below the frost line to hibernate in for the winter.** **Many frogs will actually freeze during the winter months and look frozen and dead. Frogs have a high concentration of glucose in their organs that prevents the organs from freezing. When it begins to warm up again, the frozen areas of the frog thaw and the heart and lungs resume activity.**
	**Monarch butterflies migrate to Mexico each year in order to survive. They cannot live in cold temperatures.** **Monarchs fly up to 2,500 miles to a warmer climate. They are the only insect that can fly that far.**
	**Pythons camouflage on their back allows them to blend in perfectly with leaf litter on the forest floor.**

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Station 4

Vocabulary cards

Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.
Adaptation	Sleep like state in the winter.
Camouflage	Behavior or body part that helps the animal survive.
Migration	Coloring or pattern on an animal that helps it blend in with its environment.
Hibernation	Moving from one place to another in a pattern, often to find food.

Photos courtesy of Perot Museum Stock Photos or Wikimedia Commons

Blubber mania

5.10 A. Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

ESSENTIAL QUESTION

What **adaptation** do animals that live in extremely cold environments, such as seals and whales, possess that enables them to stay warm?

LESSON OBJECTIVE

The student will learn that these animals possess a layer of fat, called **blubber**. This **layer of fat insulates** the animals and conserves their body heat by slowing the transfer of energy, allowing them to **survive** in subzero environments without freezing. The students will work together as a group and record how long it took to feel the cold water through only a sandwich bag, representing skin, versus a bag with vegetable shortening, representing a layer of blubber.

MATERIALS

Per Group	Vegetable shortening, large zip-top bags (2 per group), large pail or bowl, ice, water, 1 thermometer, 1 timer, spoon or cup for vegetable shortening, tub to wash hands, soap, newspaper to cover table.
Per Student	1 sandwich bag

DIRECTIONS

1. Take 1 of the large zip-top bags (#1) and put about 1 cup of vegetable shortening in it.
2. Take the 2nd zip-top bag (#2) and turn it inside out.
3. Put #2 inside bag #1.
4. Zip the bags together so they lock.
5. Squish shortening around evenly between the bags.
6. Take a bowl or pail and put the water in it and add ice.
7. Place the thermometer into the water. Record the temperature of the water.
8. Put one hand inside the zipped-together bag and the other hand inside a sandwich bag.
9. Have student #1 place both hands into the water, one with just a sandwich bag and one in the zipped together bag with vegetable shortening in it, at the same time.
10. Have student #2 start the timer and record the time for when student #1 felt cold through just the sandwich bag and the time student #1 felt cold through the zipped bag.

ACADEMIC VOCABULARY

Adaptation, blubber, warm, cold, coat , insulation, heat

POSSIBLE QUESTIONS

1. Make a prediction, which hand do you think will feel warmer?
2. How does fat help some animals to keep warm?
3. Would these animals that have this adaptation to stay warm in extremely cold environments do well in a warmer environment? Why or why not?

TECHNOLOGY INTEGRATION AND WEBSITES

www.utmsi.utexas.edu/k12/adaptations.pdf

PROJECTS TO EXTEND LEARNING

Make a class graph illustrating data on the recorded times.

Put thermometers inside the different types of bags.
Put 30 seconds on the timer.
See if the thermometers read the same or differently after being inside the bags, inside the icy water, for 30 seconds.

Discovering life
through structure and function

5.10A Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

ESSENTIAL QUESTION

How do animals use different body structures for survival?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Adaptation, structure, function, survival, survive, habitat, organism

Discovering life
through structure and function

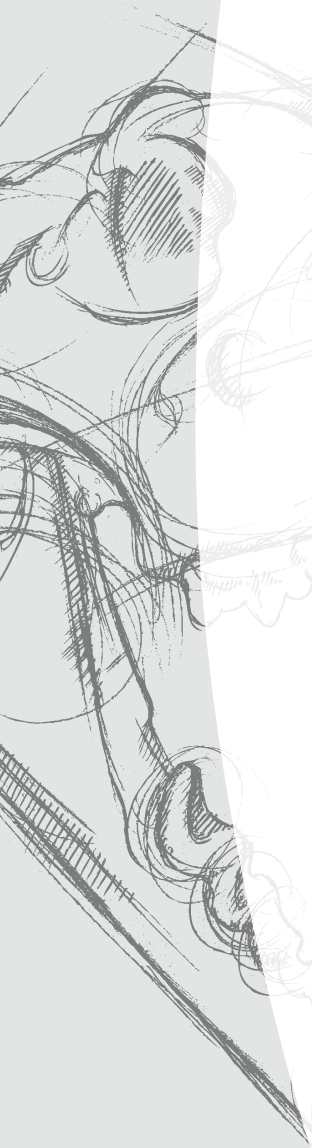
As you walk through the ANIMAL INSIDE OUT exhibit, observe the various organisms. Note their various **structures** and how they **help them to function in their environment**.

Record the information in the table below

NAME OF ORGANISM	STRUCTURE	FUNCTION

Based on your observations, how do the **structures** of the different organisms you observed **help them to survive in their environments?**

Do you think these organisms would be able to survive if they were placed in a different type of ecosystem or environment?



Grade 5

Movement and environment

5.10A Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

ESSENTIAL QUESTION

Does the environment the animal live in influence an animal's adaptations?

LESSON OBJECTIVE

The student will connect classroom learning with an activity in the museum. He/She will use the specimens in the exhibit and analyze structure and function of different animals. The student will fill out the provided table with an animal in the exhibit, identify a specific structure on the animal and describe how this structure helps the animal move, how it is related to where it lives and what it eats. For example: fins on a shark or teeth on a herbivore

MATERIALS

Per Student: Museum-School Connection page

DIRECTIONS

1. Student will complete the Museums-Connection page at the museum.
2. Follow up at school.

ACADEMIC VOCABULARY

Structure, function, survival, survive, habitat, organism

Movement and function

Choose 4 different animals to **compare** their body **structures**

ANIMAL	**DRAW A PICTURE** of the structure the animal uses to move (4 legs, 2 legs, fins, wings?)	**ENVIRONMENT** the animal lives in
SHARK		OCEAN
OSTRICH		
HUMAN		
REINDEER		

How does the way an animal **moves (locomotion)** benefit the animal in **survival?**

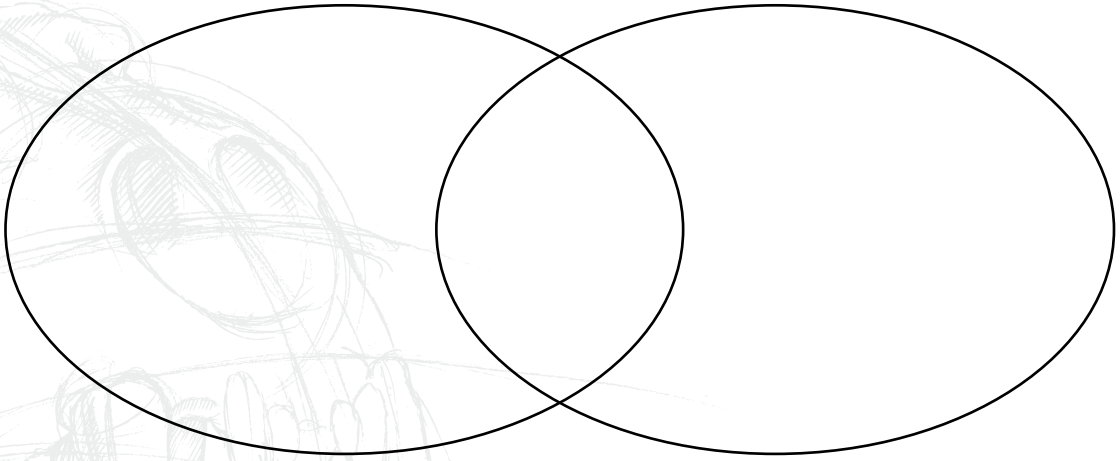
Does the **environment** the animal lives in influence the animal's **adaptation** for movement?

Movement and function

Compare/Contrast similarities and differences between the *shark and reindeer* (living/non-living, vertebrate/invertebrate, environment they live in, how they move…)

(Fill in the blank spaces)

SHARK **REINDEER**



What did you learn from doing this activity at the museum?

TRY THIS OUT
Based on the information provided in the exhibit, what type of adaptations does the shark have that help it survive in its environment?

Grade 5

Real life adaptations

TEKS 5.10A Compare the structures and functions of different species that help them live and survive such as hooves on prairie animals or webbed feet in aquatic animals.

☒ Readiness Standard ☐ Supporting Standard

ELPS

ESSENTIAL QUESTION

What animal **adaptations** could we use to make things easier for us?

LESSON OBJECTIVE

The student will explore how we use objects that **mimic beneficial adaptations** on animals. Such as swim fins while swimming. The student will make the connection that these adaptations enable animals to **survive** and thrive in their environments.

LEARNING STYLE

☐ Spatial ☐ Auditory/Musical ☒ Linguistic ☐ Kinesthetic
☒ Logical ☐ Interpersonal ☐ Intrapersonal

MATERIALS

Per Group Pictures of various animal **adaptations** and objects humans use to mimic that specific **adaptation**.

DIRECTIONS

1. Pass out the animal cards and human adaptation cards to each group.
2. Instruct the student to match the human adaptation to the animal structure card.
3. Have the students work their partner and discuss how humans and animals use these adaptations.
4. Instruct the student to write a brief explanation about the structure, how the animal uses it and how humans have found a way to mimic the adaptation to their benefit.

ACADEMIC VOCABULARY

Adaptation, structure, mimic, beneficial, survival

Real life adaptations

POSSIBLE QUESTIONS

1. Would an animal with webbed feet, meant for swimming, be as efficient on land running as they are swimming?

2. Why do you think humans mimic these adaptations? Does it help us with certain actions?

3. Can you think of an animal adaptation you wish you had and why?

PROJECTS TO EXTEND LEARNING

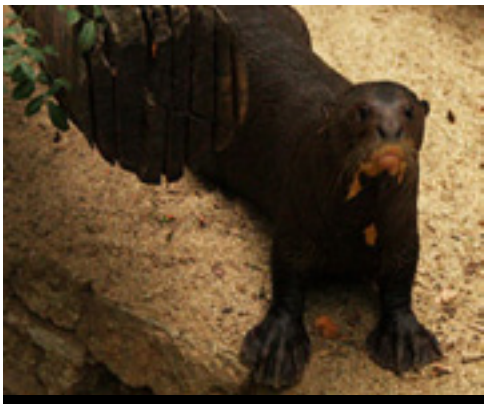
Students can create a new species of animal, selecting adaptations specific to certain animals, draw a picture of their animal and write a paragraph explaining the adaptations they chose.

Man wearing a coat

Killer whale

Bald eagle

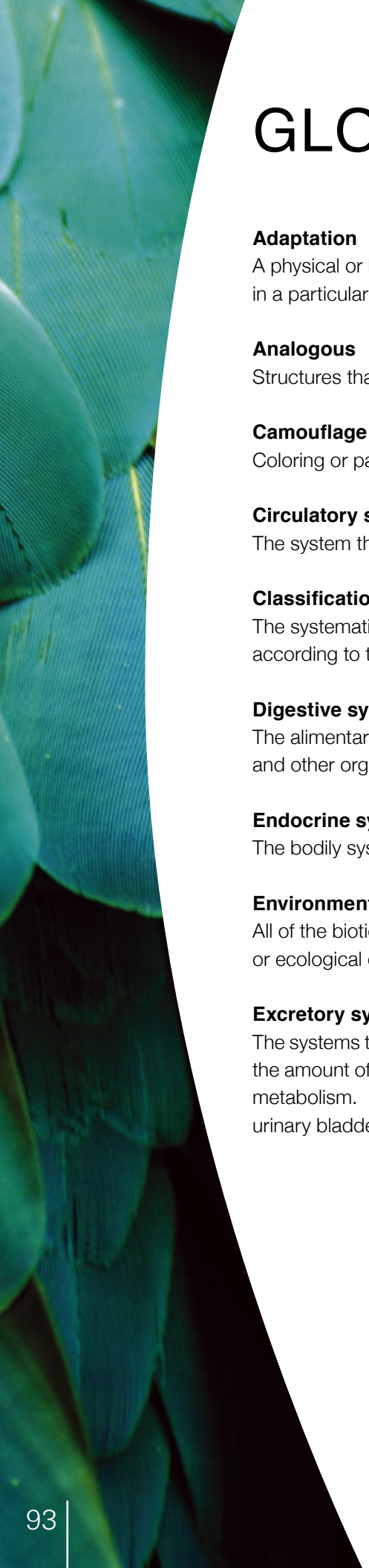
Binoculars



Otter

Swim fins

Photos courtesy of Wikimedia Commons



GLOSSARY

Adaptation
A physical or behavioral characteristic that allows organisms to better survive in a particular environment

Analogous
Structures that have a similar function, but are not genetically similar

Camouflage
Coloring or pattern on an animal that helps it blend in with its environment

Circulatory system
The system that circulates blood through the body, consisting of the heart and blood vessels

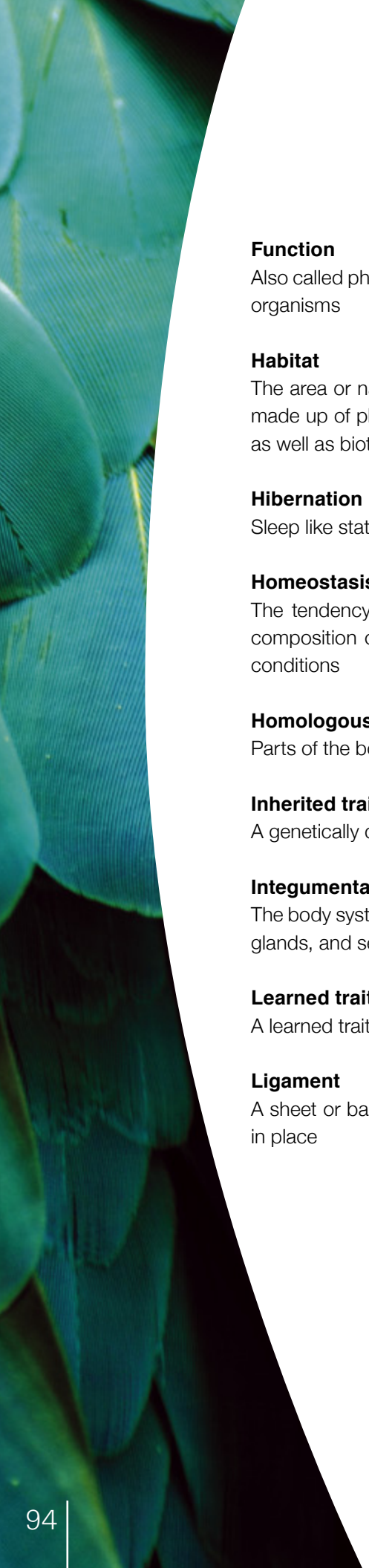
Classification
The systematic grouping of organisms according to the structural or evolutionary relationships among them

Digestive system
The alimentary canal together with the salivary glands, liver, pancreas, and other organs of digestion.

Endocrine system
The bodily system that consists of the endocrine glands and the hormones that they secrete

Environment
All of the biotic and abiotic factors that act on an organism, population, or ecological community and influence its survival and development.

Excretory system
The systems that excrete wastes from the body. For example, the system of organs that regulates the amount of water in the body and filters and eliminates from the blood the wastes produced by metabolism. The principal organs of the excretory system are the kidneys, ureters, urethra, and urinary bladder



Function
Also called physiology and includes the mechanical, physical, and biochemical processes of living organisms

Habitat
The area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food and the presence of predators

Hibernation
Sleep like state in the winter

Homeostasis
The tendency of an organism or cell to regulate its internal conditions, such as the chemical composition of its body fluids, so as to maintain health and functioning, regardless of outside conditions

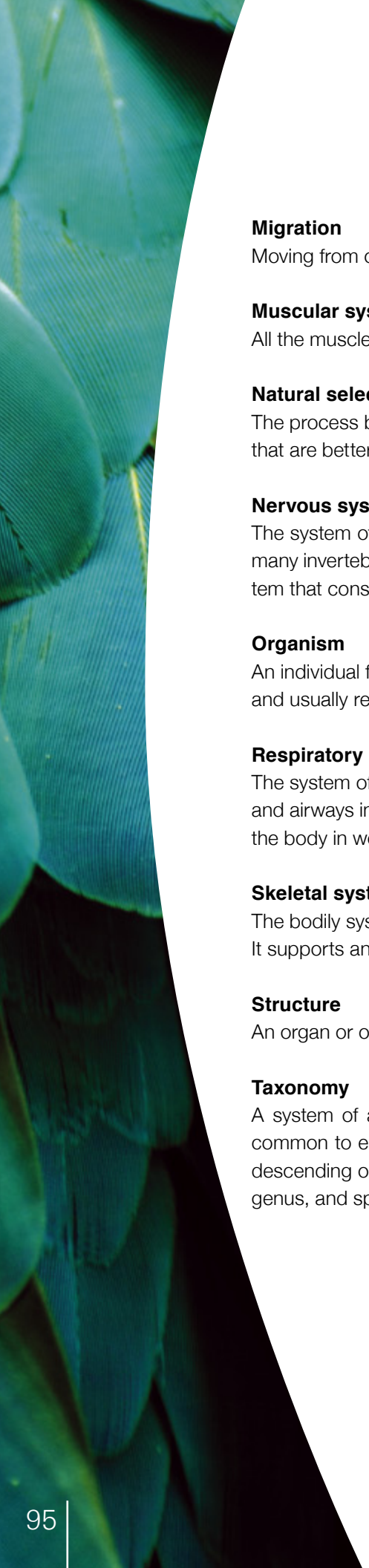
Homologous
Parts of the body that are structurally and genetically similar to other comparative species' parts.

Inherited traits
A genetically determined characteristic or condition

Integumentary system
The body system consisting of the skin and its associated structures, such as the hair, nails, sweat glands, and sebaceous glands.

Learned traits
A learned trait is a behavior that an animal develops by observing other animals or being taught

Ligament
A sheet or band of tough fibrous tissue that connects two bones or holds an organ of the body in place



Migration
Moving from one place to another in a pattern, often to find food

Muscular system
All the muscles of the body collectively, especially the voluntary skeletal muscles

Natural selection
The process by which organisms
that are better suited to their environment than others produce more offspring

Nervous system
The system of neurons and tissues that regulates the actions and responses of vertebrates and many invertebrates. The nervous system of vertebrates is a complex information-processing system that consists mainly of the brain, spinal cord, and peripheral and autonomic nerves

Organism
An individual form of life that is capable of growing, metabolizing nutrients,
and usually reproducing. Organisms can be unicellular or multicellular

Respiratory system
The system of organs and structures in which gas exchange takes place, consisting of the lungs and airways in air-breathing vertebrates, gills in fish and many invertebrates, the outer covering of the body in worms, and specialized air ducts in insects

Skeletal system
The bodily system that consists of the bones, their associated cartilages, and the joints.
It supports and protects the body, produces blood cells, and stores minerals.

Structure
An organ or other part of an organism

Taxonomy
A system of arranging animals and plants into natural, related groups based on some factor common to each, as structure, embryology, or biochemistry: the basic taxa now in use are, in descending order from most inclusive, kingdom, phylum (in botany, division), class, order, family, genus, and species.