Animal Organs at Work Field Trip Package

Description

Students will review the ways that human organs and systems work and learn how they compare to those of a variety of animals. Students will also learn that many animals have very similar organs and systems but with changes that help the animal reach the specific demands its lifestyle requires.

This information package can help you summarize ideas to help you get the most from your trip to the zoo.

Links to the New BC Curriculum

Grade 5

- Multicellular organisms have organ systems that enable them to survive and interact within their environment. *(Big Ideas)*
- Make observations in familiar or unfamiliar contexts *(Curricular Competencies)*
- Students are expected to know the basic structures and functions of the digestive, musculoskeletal, respiratory, and circulatory systems *(Content)*

Preparing for the Program

Location: In the primary years, this will be many students' first visit to the zoo and feeling prepared will help ease some nervousness younger students may have about visiting a new place. These are some things that teachers should review with their students prior to and upon arrival at the zoo.

- Where the zoo is in relation to your school.
- Duration of the trip to the zoo and mode of transportation to the zoo.
- Designated meeting place set out at the zoo in case any adult or student gets separated from the group, and point this out on the map upon arrival.

Vocabulary: Before attending the zoo, students should be aware of the following words as they may be used during the program.

- **Abomasum**: The fourth stomach in a ruminant that digests with acid
- **Bidirectional**: The breathing system that uses the same pathway like the tide
- **Bile**: A liquid released in the intestines to stop acid
- **Biodiversity**: The variety of different types of living things in an ecosystem.
- **Carnivores**: Animals that only eat meat
- **Cecum**: A pocket in the intestines with bacteria to break down plants
- **Chyme**: The mix of stomach acid and food that leaves the stomach
- **Endoskeleton**: A skeleton where the main structure is in the body (bones)
- **Enzymes**: Proteins that accelerate reactions such as digesting food

- **Esophagus**: The connection between mouth and stomach
- **Exhaling**: The process of breathing out
- **Exoskeleton**: A skeleton where the main structure is outside the body
- **Herbivores**: Animals that only eat plants
- **Hydrostatic skeleton**: Body is supported by water pressure inside the body
- **Inhaling**: The process of breathing in
- **Omasum**: The third stomach in a ruminant for mechanically squishing food
- **Omnivores**: Animals that eat both meat and plants
- **Pulmonary circulation**: The branch of circulation that goes to the lungs
- **Reticulum**: The second stomach in a ruminant for separating large objects
- **Rumen**: The first stomach in a ruminant filled with bacteria to start digestion
- **Ruminant**: A herbivorous mammal with a four-chambered stomach
- **Spiracles**: Openings for air to go in and out of the insect
- **Systemic circulation**: Circulation that goes to the main body
- **Trachea**: The tubes in an insect from the spiracle to the body, or the windpipe in mammals connecting the mouth/nose and the lungs
- **Unidirectional**: A type of respiration that always goes in one direction
- **Vertebrates**: Animals that have spines

Dressing for the weather: There are not many indoor or covered areas at the zoo, so it is important to dress for the weather.

- If raining: waterproof shoes and jackets are necessary. Umbrellas are optional.
- If sunny: sunscreen, hats, and water bottles are necessary.

Safety Guidelines: Here at the zoo, we want you to have fun, but our priority is the safety of our visitors and animals. These rules will help keep you and the animals safe.

- Do not feed the animals.
- Do not touch the animals.
- Respect all barriers and fences.

Information Guide

The animal kingdom is a diverse landscape of shapes, sizes, and behaviours, which means that every animal's body will need to fit with their specific set of circumstances. An animal that does well in the water, for example, will not do well in the middle of the desert. Humans are the animal that students are the most comfortable with because we learn about them the most in school, and for that reason we will use human organs to compare to animal organs.

Grade 5

Digestive

The digestive system is where food is taken into the body and broken down into smaller parts that can be used by the body. Usually, the steps for this are some sort of biting, chewing, swallowing, and then digesting in the stomach where the food starts being processed into smaller parts (fats, proteins, sugars). The last step is into the intestines where the nutrients, water, minerals, etc. are absorbed. All the leftovers go to the **excretory** system.

Many animals follow this system for digesting their food with only minor adjustments. We chew our food and add saliva to help start breaking down the food and slide it down the **esophagus**. The food drops into the stomach which has Hydrochloric acid (HCl) and **enzymes** to quickly break apart proteins, sugars, and fats. This mixture gets pushed into the intestines where it continues to be broken down and covered in **bile**. This soupy mixture then goes through the small intestine where the proteins, sugars, fats, nutrients, and minerals get absorbed. What is leftover goes into the large intestines where water is taken out, and everything else is excreted or eliminated from the body.

For **vertebrates**, most digestive systems are similar and only a few are drastically different from a human's. Some of the small changes happen because of the diet of the animal, such as for **carnivores** and **herbivores**.

There are **differences in teeth** depending on what type of food you eat. Carnivores need to rip meat but don't really chew, so they have sharp teeth for ripping and cutting but no molars for grinding. Herbivores only have molars for grinding up plants with some teeth at the front to help crop grass. **Omnivores** have both cutting teeth at the front of their mouth and molars for grinding at the back of their mouth.

In the intestines there is a part called the **cecum (or caecum)**. The cecum is an end pocket that stores bacteria to help break down plants. In herbivores the cecum and the intestines are very long to give more time to break down plants. In carnivores, the intestines are shorter, and the cecum is very small because digesting meat can be done quickly, and plants don't need to be digested. Omnivores, like humans and bears, would be somewhere in the middle because we eat both meat and plants.

Two of the bigger changes to the digestive system are in birds and animals called ruminants.

Ruminants are herbivores like **cows, camels, and giraffes** that have four chambers to their stomach. The four chambers are the **rumen, reticulum, omasum, and abomasum**. Ruminants chew and swallow with the food ending up in the rumen where it will be broken down by bacteria. They will then regurgitate that food back into their mouth, chewing and swallowing it again. Once the food is broken down it will be pushed into the reticulum where big objects like sticks will be filtered out and pushed back into the rumen to be broken down more. Food that makes it past the rumen goes into the omasum where the muscles squeeze and squish the food. Finally, the food goes into the abomasum which works like our stomach. What is left continues down the intestines for

more nutrient and water collection until it is eliminated from the body. With all that digestion ruminants can still leave as much as 50% of the nutrients undigested.

Birds don't really have teeth to chew, so the rest of their digestive system needs to make up for that. First, they have a **crop** where food can be stored and until ready to be digested, and where crop milk is produced to be regurgitated to its young. The second adjustment is the **gizzard**, which is the muscular part of the stomach. The gizzard squeezes the food to break and mash it up after it has gone through the **proventriculus,** which is like our stomach where enzymes and acids are added to the food. Birds often swallow small stones to help break up the food more in the gizzard.

Skeletal

The human skeletal system is called the Musculoskeletal system or **endoskeleton** and is one of three main types of skeletons. There are bones throughout the body that muscles, tendons, and ligaments, are attached to. The muscles pulling on the bones make the limbs and body move around and this structure helps with flexibility, but with the trade-off of being soft and vulnerable to attacks.

Some adaptations of the endoskeleton system are found in birds as well as turtles and tortoises. **In birds** the adaptation is that the bones are hollow and in places like wrists and ankles are fused. Being fused together gives strength to the bones, while having hollow bones makes the bird lighter and allows them to be faster as well as lighter to help with flying or running quickly. **In Turtles and Tortoises,** the skeleton's biggest difference from other musculoskeletal systems is the shell, which is made from modified rib bones. While the baby is growing in the egg the ribs would develop the same as a humans; long and pointy. But once they are finished this stage of growth they grow again. This time they would grow towards each other, filling in the space between the ribs until they collide and fuse together with the other ribs and making the shell.

There are two other main types of skeletons in the Animal Kingdom. One is the **Exoskeleton** and is a feature of invertebrates in land, air, and water. The other is the **Hydrostatic skeleton** and is only found in the water.

Exoskeletons are found on insects, crustaceans, and many other types of animals all over the world. These animals have no hard bones or cartilage on the inside of their bodies. Their outside coverings are often hard and are the main point any muscles will be attached. While well protected from the exoskeleton one drawback is the need to molt their shell in order to grow, resulting in a vulnerable and temporarily softer animal.

Hydrostatic skeletons are found in animals that have soft bodies and no bones. Their entire body structure depends on the pressure of water they make inside of their bodies. Sea anemones, jellyfish, earthworms, and caterpillars are examples of a hydrostatic skeleton since they have no endoskeleton and no exoskeleton. They take water into their body, and it flows into a bunch of tubes and pockets throughout their body to give it shape. Some of these animals use water pressure and squeezing to move around, such as

sea anemones, but others, like caterpillars, would have some muscles and ligaments that would pull against the pockets of water to let their legs and body move.

Respiratory

The human respiratory system is a staple for the way we think of breathing. We have a **bidirectional** respiratory system which means we breathe in and out of the same pathway like the tide on the beach. We breathe in, from nose or mouth to the trachea and into the lungs, and then exhale back to the trachea and out the nose or mouth. While the air sits in the lungs oxygen gets pulled into the **Circulatory system** and carbon dioxide gets pulled into the lungs. One of the many animals that have modified the tidal system would be frogs.

When **Frogs** are adults they breathe through their nose and mouth in a tidal fashion similar to humans but have a secret way of breathing in the water. When they need to stay underwater for a long time they can get a little bit of oxygen through their back thanks to a whole bunch of blood vessels really close to the skin. They can also get oxygen just by holding air in their mouth because of extra blood vessels and surface area.

Unidirectional respiration is the second type of respiration. Unidirectional flow means that the air never follows the same route out of the body as it came in. Fish are the most common animals to breathe this way. Water flows into the mouth of the fish and then out of the gills, where oxygen is pulled out of the water. The flow only goes in one direction.

Birds have changed bidirectional breathing into a type of **unidirectional flow.** Their breathing is a little more complicated than ours but helps with giving lots of oxygen for flying. The air takes two full breaths to leave the body and travels in two stages, each with **inhaling** and **exhaling**.

For the **first stage,** the inhaled air goes into the mouth and into the trachea, where some of the air goes into the lungs, and the rest goes into a sack below the lungs. This is called the posterior sack or sack at the back. When exhaling, the air in the lungs will leave out the mouth, but the air in the posterior sack will be pushed into the lungs.

During the **second stage,** when inhaling, the air in the lungs goes to the anterior sack, or sack at the front. When the animal exhales the air in the anterior sack will push the air into the lungs and then out the trachea to complete the journey. Having this complex system for breathing means that there is almost always some sort of air for the animal to get oxygen from and allows it to do very strenuous activities.

Insects are a bit different when they breathe because they can't use their mouth or nose. Insects often have **spiracles,** which are little openings in their shell, and those holes lead into **trachea**. In insects, trachea are tubes that spread through the body and trade oxygen and carbon dioxide directly into their hemolymph and muscles (which we will discuss in

the Circulatory section), instead of bringing the air to a lung. Some insects have bidirectional breathing in and out of the spiracles (or gills for some aquatic insects) and some are unidirectional like larval dragon flies where the water and oxygen comes into their gills and then out their anus as to act as a form of jet propulsion through the water.

An amazing resource for visual learners can be found at this site showing insects, mammals, and birds respiring. http://tabletopwhale.com/2014/10/24/3-different-ways-to-breathe.html

Circulatory

The human circulatory system is a little intimidating at first glance, but overall follows a fairly logical path. The human heart has 4 chambers separated into top or bottom, and left or right. It is important to remember that left and right when looking at a diagram are reversed because the directions are from the picture's perspective. The two top parts of the heart are **atria** (atrium for one) and the bottom two are **ventricles.** In a four chambered heart there are two parts called **pulmonary circulation** and **systemic circulation.** In pulmonary circulation blood comes into the heart in the right atrium, is pushed into the right ventricle, and then pushed to the lungs, where it loops back full of oxygen to the left atrium. Systemic circulation starts at the left atrium where blood is pushed into the left ventricle, and then pushed to every part of the body to come back to the right ventricle. The heart is a very strong pump and like any muscle needs regular exercise to stay strong.

Not every animal has a four chambered heart. Fish often have a two chambered heart made of one atrium and one ventricle that pushes blood past the gills to get oxygen and then through the body. **Amphibians** and many **reptiles** have a three chambered heart with one ventricle and two atria. The two atria take blood in from the body and from the lungs and then take turns pushing blood to the ventricle to be pushed around to the body and to the lungs. The three chambered heart is not perfect and does sometimes mix the oxygenated and deoxygenated blood. **Crocodilians** are the only reptiles that have a four chambered heart.

Insects have a drastically different circulatory system from what we are used to. One difference is that insects have something called an **open circulatory system**. This means they have no veins, arteries, or other blood vessels. **Hemolymph** is very important, like hemoglobin in our blood and carries nutrients around the body in a sort of open pool, but like a pool there has to be a pump somewhere. Insects have a long pump along their back that we call the heart but looks more like a tube. The long tube stretches from the head, through the thorax, and to the end of the abdomen. There are small intake areas in the abdominal section where the hemolymph is picked up and then pumped up to the head where it bathes the brain. The hemolymph then slowly makes its way back to the abdomen whenever the current of hemolymph brings it back.

You have made it to the end! But before you go, I want to make sure we remember a few key points from what we have read. Not every animal functions the same, but once you know how the human systems work it is easy to compare to different animals. Every animal needs to get nutrients and oxygen, have a shape, reproduce, and get rid of their wastes, to name a few necessities. Each animal is going to have a system in place that helps their specific lifestyle and are not going to want extra steps that don't help them. For example, an endoskeleton isn't going to help a sea anemone survive when a hydrostatic skeleton works perfectly fine for holding its shape in water.