# Biodiversity
## for Grade 11 University
## at the Toronto Zoo

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## PRE-ZOO ACTIVITY

**These activities are designed to prepare your students for the zoo activity. They should take about 35 minutes each to complete.**

**Purpose:**
To provide students with the basic knowledge of classification systems and adaptational diversity, so they can be well prepared for the zoo activity.

**Curriculum Connection:**
By the end of these activities, students will:

- Define the fundamental principles of taxonomy and explain how species are categorized and named according to structure and/or evolutionary history.
- Describe selected anatomical and physiological characteristics representative of the animal kingdom.
- Explain the importance of sexual reproduction to variability within a population

**Note:**
Due to the complexity of these expectations, 3 different activities have been suggested for your students. Each activity covers an important component of the expectations. It is advised that you pick the one that is most necessary for your class. Or, if time provides, utilize them in succession. It is imperative that the students have a good knowledge of all these fundamentals for the zoo activities.

Before the trip, it is strongly encouraged that all students participate in the pre-zoo homework activity designed to familiarize the students with the zoo and the concepts they will be studying (see below).

**Any page numbers written beside a sentence correlates with information provided in Nelson Biology 11**

### Pre-Zoo Homework Activity

**Objective:**
This is a question/answer activity based on concepts in regards to adaptation, biodiversity and zoogeography.
It is an opportunity for the students to gain some familiarity into the concepts they will be focussing on at the zoo.
The teacher should hand out this activity before the actual zoo trip and expect that the students complete the questionnaire for homework. It should be handed in no later than the morning of the trip.

See appendices for the assignment and answer key (pgs 6-7).

Before your trip to the zoo, take a look at this!
**Directions: Read article and answer questions**.

## The Origin of New Species

The biochemical similarity of all living species indicates that life on Earth probably originated only once, about 3.5 billion years ago. From one original species came the millions of species found on Earth today. The process of new species formation, known as **speciation**, is continuing today and will most likely continue in the future.

The process whereby one original species evolved into new, distinct species was first described by Charles Darwin and Alfred Russel Wallace more than 100 years ago. This theory of the origin of new species is widely accepted today in the scientific community. Darwin provided abundant and convincing evidence for his theory in his classic book, *On the Origin of Species* (1859). The wealth of new information provided by the fossil record and by modern molecular biology research has continued to support his theory.

The theory of evolution is both simple and elegant. Imagine a population of species of mountain rabbits, living in Canada. Individuals in the population tend to produce more offspring than can survive in that place. Most offspring will die before reaching maturity. In the population of rabbits, one pair of rabbits will produce numerous litters of six or more babies, yet on average, in a stable population, only two of those offspring will survive. Individuals in the population show variations in certain characteristics, and some of these characteristics are inherited, meaning that they are passed genetically from parent to child. These genetic variations are caused by spontaneous changes in the chromosomes and by the rearrangement of chromosomes during sexual reproduction. Within the rabbit population, some individuals have thicker fur than others because of genetic differences. These differences in genetic characteristics will enable some individuals to grow, survive, and reproduce better than other individuals, an idea that is often referred to as "survival of the fittest." Our pretend thick- furred rabbits will be more likely to survive cold winters than rabbits with thinner fur. As a result of the improved survival ability provided by a certain genetic characteristic, the individuals with that characteristic will be more likely to produce offspring than the others; over time, the genetic composition of the population will change. After a series of cold winters, more thick-furred rabbits will have survived and produced thick-furred offspring while more thin-furred rabbits will have died.

In the process of evolution, populations are constantly adapting to changes in their environment. These changes may be biological (new food, new competitors, new prey) as well as environmental (changes in climate, water availability, soil characteristics). When a population has undergone so much genetic change that is no longer able to interbreed with the original species from which it was derived, the population can be considered to be a new species; this process whereby one species is gradually transformed to another species is termed **phyletic evolution**. The history of the evolution of a species is called **phylogeny**.

In order for two or more new species to evolve from one original ancestor, there usually has to be a geographical barrier that prevents the movement of individuals between the various populations of a species. For terrestrial species, these barriers may be rivers, mountain ranges, or oceans that the species cannot readily cross. Speciation is particularly rapid on islands. Island groups such as the Galapagos and the Hawaiian Islands have many examples of insect and plant groups that were originally local

populations of a single invading species. These local populations adapted genetically to the environment of particular unoccupied islands, mountains, and isolated valleys, and have diverged sufficiently from the original species to now be considered separate species. This process of local adaptation and subsequent speciation is known as **adaptive radiation**. One of the best-known examples of adaptive radiation is that of the Hawaiian honeycreepers, a group of specialized bird species that apparently derives from a single pair of birds that arrived by chance in the Hawaiian Islands tens of thousands of years ago.

Even though new species are arising all the time, the present rate of species extinction is probably more than 1000 times faster than the rate of speciation. The situation is actually worse than this grim statistic suggests. First, the rate of speciation may actually be slowing down because so much of the Earth's surface has been taken over for human use and no longer supports evolving biological communities. There are now fewer populations of each species and thus fewer opportunities for evolution. Many of the existing protected areas and national parks may be too small in area to allow the process of speciation to occur. Second, many of the species threatened with extinction are the sole remaining representatives of their genus of family. The extinction of these taxonomically unique species representing ancient lineages is not balanced by the origin of new species. **Biodiversity** stands for the diversity of living things, and every time a species becomes extinct its genetic material is lost causing a decrease in our earth's biodiversity.

Cited From - **Primack, R**. 1993. Essentials of Conservation Biology,
Sinnauer Associates Inc., Massachusetts

**Answer the following questions based on the previous article**

1. Who was Charles Darwin?

   _____

2. What is evolution and give an example of how it occurs?

   _____
   _____
   _____

3. What is the definition of a species?

   _____

4. What is the definition of phylogeny and phyletic evolution?

   _____
   _____
   _____

5. Why would a population need to adapt to changes in its environment? What types of changes do populations need to adapt too?

   _____
   _____

6. What is speciation?

   _____

7. In order for speciation to occur, what type of barrier must usually be present

   _____

8. What is adaptive radiation and give an example of it occurring in nature

   _____
   _____
   _____

9. Why is it important that speciation continue to occur?

   _____
   _____

10. The Toronto zoo houses the largest frozen sperm bank in North America. This means that sperm from the Toronto Zoo is shipped all over North America to other zoos, for captive breeding and research. These sperm also hold a lot of genetic information. Why is it important that zoos try to keep samples of as many different types of genes from an animal population (e.g., elephants) as possible? **Answer on back side of paper.**

ANSWER KEY - HOMEWORK ASSIGNEMENT FOR PRE-ZOO ACTIVITY

# Answer the following questions based on the previous article

1. **Who Was Charles Darwin?**
   One of first scientists to describe distinct species in process of evolution. Wrote *Origin of Species* (1859) and termed coin "survival of the fittest".

2. **What is evolution and give an example of how it occurs?**
   Evolution: genetic change in a population overtime.
   Example: Gradual changing over generations in the fur of rabbits from thin to thick, to bear the colder winter.

3. **What is the definition of a species?**
   A population of animals that are able to interbreed and produce fertile offspring.

4. **What is the definition of phylogeny and phyletic evolution?**
   Phylogeny: History of the evolution of a species
   Phyletic evolution: Process whereby one species is gradually transformed to another species.

5. **Why would a population need to adapt to changes in its environment? What types of changes do populations need to adapt too?**
   A population needs to adapt to changes in its environment in order to continue to survive.
   Populations need to adapt to biological (new food, new competitors, new prey) conditions and environmental (change in climate, water availability, and soil characteristics) conditions.

6. **What is speciation?**
   Speciation: Process of new species formation.

7. **What is adaptive radiation and give an example of it occurring in nature?**
   Adaptive radiation: process of local adaptation and subsequent speciation.
   Example: Hawaiian Honeycreepers which are thought to have been derived from a single pair of birds arriving on Hawaiian Islands. Speciation can be seen by the various beak structures of the different species in this family.

8. **In order for speciation to occur, what type of barrier must usually be present?**
   A geographical barrier must usually be present.

9. **Why is it important that speciation continue to occur?**
   Speciation is necessary to keep the different taxa thriving and surviving. It is important to have as wide a variety of genetic information as possible so the animals have more chance of surviving.

10. **The Toronto zoo houses the largest frozen sperm bank in North America. This means that sperm from the Toronto Zoo is shipped all over North America to other zoos, for captive breeding and research. These sperm also hold a lot of genetic information. Why is it important that zoos try to keep samples of as many different types of genes from an animal population (e.g., elephants) as possible? Answer on back side of paper.**
    One of the major functions of zoos is conservation. Thus they usually house animals that are endangered or threatened with extinction. As the population decreases, so does the genetic variance and thus their chances for survival are lessened. The zoo tries to keep as much of the genetic information on hand to not only act as a library but also to try and maintain as much genetic variation within a population as possible.

**Page numbers correlate with information provided in Nelson**
**Biology 11**

# Activity 1

**Time:**
35 minutes

**Objective:**
To differentiate between the vertebrate classes and learn about the invertebrates, as well as introduce the concept of taxonomy and classification.

**Materials for teacher:**
- Picture handout of organisms belonging to Class Aves (pg 462) - see appendices
- Picture handout of organisms belonging to Class Reptilia (pg 457)– see appendices
- Picture handout of organisms belonging to Class Mammalia (pg 465)– see appendices
- Picture handout of organisms belonging to Class Amphibia (pg 455)– see appendices
- Picture handout of organisms belonging to the 3 Fish Classes (pg 452)– see appendices
- Picture handout of organisms belonging to the Invertebrate Classes (pg 410) – see appendices
- Phyla Chart (411) – see appendices pg. 14
- Chart of invertebrate versus vertebrate percentages (pg 448) – see appendices pg. 15
- Teacher answers: Characteristics of various Classes – see appendices pgs. 10-13
- 6 pieces of chart paper
- 6 markers and tape

**Materials for Students:**
- Paper
- Pen/Pencils

**Jigsaw Activity:**
1. Divide class into groups of 6. Each of these groups are the "expert" groups. Make sure each group has an associated number (i.e., all students belonging to the Class Aves group are number 1, all students belonging to the Class Reptilia group are number 2, etc).

2. Give each expert group one picture handout from one of the 5 different Vertebrate Classes or the Invertebrates.

3. Have each group hypothesize on chart paper the characteristics belonging to this Class (both anatomical and physiological). Make sure that each student is keeping track of their own notes on a separate piece of paper.

**Some questions to guide this part of the activity could be:**
How do they move?
What do they eat?
What type of covering do they have?
Where do they live?
How do they give birth? Live young or not?
Are they cold blooded or warm blooded?
How do they breathe?

PRE-ZOO ACTIVITY Activity 1 - CONTINUED

**Page numbers correlate with information provided in Nelson Biology 11**

4. Switch groups into their "jigsaw" counterparts. Make sure that each new group has a member from each previous expert group. Thus, each group will have a student whose number was 1, a student whose number was 2, a student whose number was 3, a student whose number was 4, a student whose number was 5 and a student whose number was 6.

5. Have the students in each jigsaw group, compare and contrast their findings with each other.

6. Hang chart sheets and compare as a class. This allows the teacher to add in any information or correct misguided information.

7. As a class discuss features similar amongst vertebrates and invertebrates. Discuss differences.

8. Bring in the idea that the similarities between the vertebrates and invertebrates allow scientists to group them together, and they call this grouping: Kingdom Animalia.

9. However, due to the differences, they have to provide sub-categories, where vertebrates belong to the Phylum Chordata and invertebrates belong to all the other 9 Phyla (pg 411) – show Phyla chart.

10. Show students chart comparing the global biomass of vertebrates to invertebrates. This not only shows the relative smallness of vertebrates, but also provides a brief introduction to understanding classification methods.

PRE-ZOO ACTIVITY
**TEACHER ANSWERS – CHARACTERISTICS OF VARIOUS CLASSES**

**Questions to Ask:**
**How do they breathe?**
**How do they give birth? Live young or not?**
**What type of covering do they have?**
**Are they cold blooded or warm blooded?**
**How do they move?**
**What do they eat?**
**Where do they live?**

# Class Aves

- Lungs attached to ribs and connected to air sacs extending between internal organs.
- Young hatched from hard-shelled eggs, which are incubated externally.
- Body temperature is regulated (warm blooded).
- The body is covered with feathers. Mouth is a beak or bill.
- Two pairs of limbs, one modified as wings, the other pair adapted for perching, walking or swimming.
- Most can fly
- Since birds maintain a high body temperature and are usually active they consume high energy foods. They have limited fat storage and cannot survive long without food. The diet is specific for most birds: quail and chicken-like birds eat vegetation, insect-eaters eat little else, shore birds dine on fish, herons eat frogs and fish, hawks prefer snakes, lizards, rodents and birds and vultures feed only on dead animals.
- Most are carnivorous, some are herbivorous.
- Found in all continents, most islands, on seas and in both Arctic and Antarctic. Each species occupies definite geographic regions and a particular habitat. Many follow migration routes.
- Nest in trees or on ground.

## Extra notes from Pages 461-465 Nelson Biology 11

- Believed to have descended from bipedal, crocodile-like reptiles that existed about 160 million years ago.
- Have thick bones, teeth, and a long bony tail.
- Feathers, which evolved from the scales of the bird's reptilian ancestor are the one trait that is unique to birds.
- Feet used for grasping, wading, swimming, perching or clinging.
- Beaks used for tearing, spearing, filtering, cracking, chiseling.
- Feathers first used for insulation, then turning to flight. The flight feathers consist of a hollow shaft to which are attached small branches called barbs and barbules. Different feathers on a bird are used for different purposes (e.g., flight, insulation)-pg 464.
- The respiratory system of a bird is the most efficient of all chordates.
- Birds have lungs and many have air sacs that promote efficient gas exchange and buoyancy.
- Have a four-chambered heart with complete separation between oxygenated and deoxygenated blood.
- To reduce weight, they lack urinary bladders and extract a semisolid uric acid.
- Digestion is rapid and efficient, but birds must east large amounts to provide energy for flight and maintain body regulation.
- Birds have acute color vision.

PRE-ZOO ACTIVITY
**TEACHER ANSWERS – CHARACTERISTICS OF VARIOUS CLASSES**

# Class Mammalia

- Breathe with lungs.
- Young are born live – viviparous (exceptions are monotremes like the platypus and echidna which lay eggs).
- Nurses young with mammary glands.
- Body temperature regulated (warm-blooded).
- Have hair on their body. Have teeth and skull and bony skeleton.
- Move by using limbs, usually 4.
- Carnivorous, Omnivorous, Herbivorous.
- Found in all parts of the world.

## Extra notes from Pages 465 –471 Nelson Biology 11

- Only early mammals are egg layers, referred to as monotremes that reproduce by laying eggs.
- Mammals that give birth to partially developed embryos that continue to develop in the mother's pouch are marsupials (i.e., kangaroos, koala).
- About 95% of mammals are placental mammals.
- Monkeys, apes and humans are classified into New World, Old World and Hominoids (apes and humans).
- New World monkeys found in South and Central America are tree-dwelling, usually have long prehensile tail.
- Old World Monkeys found in Asia and Africa do not have prehensile tails and possess sitting pads.
- Apes are those that closely resemble humans, and lack tails, live in forests and walk on all four limbs. Most are vegetarians expect chimpanzees and they use simple tools.
- Typical mammal is warm-blooded, air-breathing, four-legged vertebrate. It's skin is covered with hair and may be equipped with sweat glands to help control body temperature. They have fleshy lips and a middle ear.
- Teeth may be of 4 different types and are fixed into sockets in the jawbone.
- Teeth are incisors, canines, premolars and molars.
- The most distinctive mammalian characteristic is the presence of mammary glands on female adults, which secrete milk to nourish the developing young.
- Feet are plantigrade (whole foot is placed on ground), digitigrade (walking occurs on digits), unguligrade (walking on tips of toes covered by hooves).
- Hair contains the protein Keratin which also makes up parts of other structures like antlers, horns, toes, etc

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# Class Reptilia

- They breathe with lungs.
- Body temperature is variable with the environment. So they are cold blooded (ectothermic).
- Young are born oviparous (eggs) or may be retained in the female's body until hatching, ovoviviparous.
- Body is covered with dry skin. Usually scales or scutes.
- Young resemble adults when they hatch
- Reptiles usually move by two pairs of limbs. In lizards these may be very reduced, paddle-like in marine turtles or absent in snakes and a few species of lizard.
- Most reptiles are carnivorous. Some are herbivorous.
- Most live in tropical and subtropical regions, but in general occupy a wide variety of habitats. Turtles and snakes are most commonly found in humid regions; lizards in more arid territory. Most lizards and snakes are ground dwellers; crocodilians inhabit swamps, rivers and sea coasts.
- There are 5 divisions of reptile: snakes, lizards, amphisbaenas, turtles, and crocodiles.

PRE-ZOO ACTIVITY
**TEACHER ANSWERS – CHARACTERISTICS OF VARIOUS CLASSES**

## Extra notes from Pages 457- 460 Nelson Biology 11

- The dry, waterproof skin of a reptile reduces water loss, but is unable to exchange gases.
- To exchange gases on land, reptiles have lungs that have internal folding which increases the surface area to exchange gases.
- Amniotic egg: A key factor that allows vertebrates to inhabit the land. It has allowed reptiles to spread into some of the direst areas of Earth and is generally leathery or calcified shell.
- Limbs probably evolved from the lobe-finned fish.

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# Class Amphibia

- Breath with lungs and gills, have a three-chambered heart.
- Skin moist, glandular and permeable and a bony skeleton.
- Fertilization occurs in water. Reproduction is dependent on an aquatic environment. Young hatch from eggs and do not resemble their parents in morphology. Young undergo a metamorphosis.
- Body temperature is variable with the environment (cold- blooded or ectothermic).
- Walk, jump, glide. Most have two pairs of legs, often with webbed feet (except for the caecilians).
- Adults are meat-eaters. Larval forms eat plants and/or meat.
- Three divisions legless amphibians which include the worm-like caecilians
  Tailless amphibians which include frogs and toads
  Tailed amphibians which include salamanders and newts
- Found in freshwater areas across world. Never found in saltwater.

## Extra notes from Pages 455 –457 Nelson Biology 11

- Amphibians have two lives:
  - Eggs are laid in fresh water.
  - Tadpole stage where they are generally herbivores and exchange gases through gills like fish.
  - Tadpoles then change into adult forms that live on land are generally carnivores.
  - Adults have 3 chambered heart unlike fish.
  - Can exchange gases through skin as well.

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# Fish Classes

- Breathe with gills. Fish have a 2 chambered heart.
- Eggs are laid in water and fertilization is often external in water. The eggs contain yolk for nourishment.
- Body is covered with scales and there is no neck.
- Body temperature variable with environment (cold-blooded).
- 3 Classes; Agnatha, Chondrichthyes, Osteichthyes
- Use fins and tail to move in water. Jaws and fins also act as stabilizers.
- Live in both fresh and saltwater around world.
- Excellent smell. Can see but have no eyelids or tear ducts and have sensitivity to low frequency vibrations and pressure waves. Balance themselves through semi-circular canal of ears.
- Eat meat or vegetation such as plankton/alga.

PRE-ZOO ACTIVITY
**TEACHER ANSWERS – CHARACTERISTICS OF VARIOUS CLASSES**

## Extra Notes from pg 452-455 Nelson Biology 11

- Most numerous and widespread of the vertebrates.
- 59% live in salt water, 40% live in fresh water and the remaining 1% move between both habitats.
- **Class Agnatha**: Jawless fish that are covered in slimy skin and lack paired fins They have eel-like bodies with a notochord and a skeleton made of cartilage. They are represented by lampreys and hagfish. Lampreys spawn in a stream and adults migrate to lake or sea. The mouth of a lamprey is sucker like and lined with teeth. The adult attaches itself to prey and tears hole through flesh and sucks out blood and fluid. They are a big problem in Great Lakes. Hagfish are bottom dwellers and act as scavengers. The mouth of a hagfish is surrounded by feelers but has row of tooth-like plates that can tear the flesh from its prey.
- **Class Chondrichthyes**
    - Sharks, skates, and rays.
    - Have cartilaginous skeleton.
    - Have jaws and paired fins.
    - Sharks fertilize internally and can give birth to live young. They most often prey on other fish.
    - Skates and rays have enlarged pectoral fins and are flattened for living on bottom of ocean.
- **Class Osteichthyes**
    - Bony fish and most numerous vertebrates.
    - Trout, perch, sole, eel, halibut, tuna, etc.
    - Have operculum and swim bladder.

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## Invertebrates – Notes from parts of Chapter 11 in Nelson Biology 11

Comprise more than 95% of all known animal species.

- Major phyla are Porifera (sponges), Cnidaria (jellyfish, hydra), Plathyhelminthes (flatworms), Nematoda (roundworms), Rotifera (wheel animals), Annelida (segmented worms), Mollusca (mollusks), Arthropoda (arthropods), Echinodermata
- Focus on Arthropods
    - Have an open circulatory system, with blood bathing a system of open spaces called a hemoceol. In many groups, such as insects, they have a tracheal system to help exchange of gases.
    - Have internal fertilization. The eggs of some species develop directly into a form that resembles the adult, but others have a nymph stage (free living stage after the egg) where they differ from the adult in certain ways like lack of sex organs and number of appendages. Many groups also have a larval stage where they must undergo metamorphosis.
    - Has an exoskeleton or cuticle composed of chitin, a nonliving material that may be thick and heavy or thin and light. Generally have fused segments that form a head, thorax and abdomen. Located on the fused segments are highly specialized jointed appendages that may be sensory or adapted for food manipulation.
    - Cold blooded.
    - Insects, centipedes, scorpions, spiders, mites, ticks, crabs, lobsters and barnacles.
    - Carnivores, Herbivores, Detritivores.
    - Crawl, walk, fly, swim.
    - Found in all habitats including Arctic ice, deserts, deep ocean, mountains, prairie ponds and skies overhead.

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**Grade 11- Biodiversity**

**PRE- ZOO ACTIVITY 1**

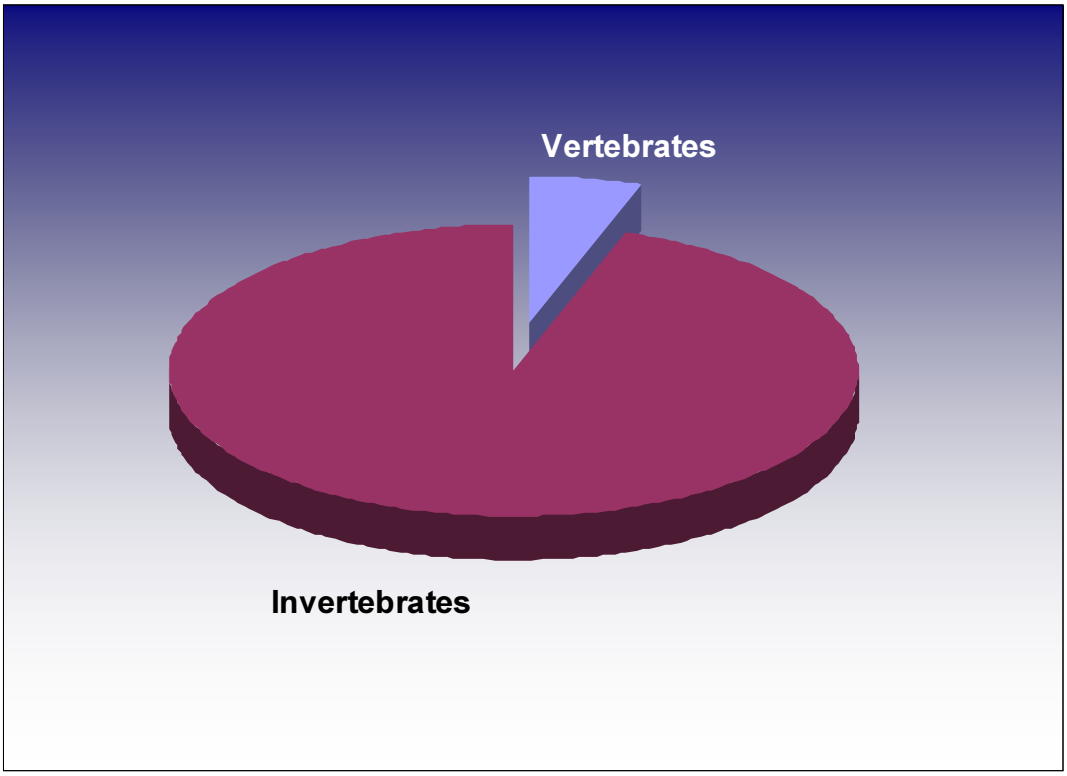
**PHYLA CHART**

**HANDOUT- MAJOR PHYLA OF THE ANIMAL KINGDOM**
**SEE PAGE 411 OF NELSON BIOLOGY 11**

| Phylum (common name) | Representative members | Description | Approx. no. of species |
|---|---|---|---|
| 1. Porifera (sponges) | giant sponge vase, redbeard sponge | • Sessile<br>• Irregular shape<br>• No mouth or digestive cavity<br>• Marine and freshwater | 5 000 |
| 2. Cnidaria | jellyfish, hydra | • Sessile or motile<br>• Medusoid form and polyp form in life cycle of some organisms<br>• Stinging nematocysts<br>• Radial symmetry<br>• Marine, with a few freshwater | 10 000 |
| 3. Platyhelminthes (flatworms) | turbellarians, flukes, tapeworms | • Free-living in marine or fresh water, or parasitic<br>• Body flattened dorsoventrally<br>• Mouth but no anus | 19 000 |
| 4. Nematoda (roundworms) | hookworm, pinworm, vinegar eel | • Cylindrical, slender, tapered at either end.<br>• Free-living or parasitic<br>• All habitats | 20 000 + |
| 5. Rotifera (wheel animals) | rotifers | • Anterior and ringed with cilia, posterior end tapering to a 'foot' | 1 500 |
| 6. Annelida (segmented worms) | earthworms, leeches, polychaetes | • Segmented body<br>• Terrestrial and aquatic<br>• Mouth and anus | 12 000 + |
| 7. Mollusca (mollusks) | snails, clams, squids, octopus | • Muscular foot<br>• Shell present in many forms<br>• All habitats | 1 000 000 + |
| 8. Arthropoda (arthropods) | insects, crab, mites, ticks, spiders, centipedes | • Segmented body, some segments may be fused; jointed appendages; external skeleton<br>• All habitats and modes of life, including parasitism | 1 000 000 + |
| 9. Echinodermata | starfish, see cucumbers, sea urchins | • Adults have 5-sided radial symmetry<br>• Marine | 7 000 |
| 10. Chordata (chordates) | fish, amphibians, reptiles, birds, mammals | • notochord at some time in life history<br>• all habitats | 7 000 |

# BIODIVERSITY OF LIVING THNGS

## INVERTEBRATES VS. VERTEBRATES




**While Invertebrates account for more than 1 million different species, chordates consist of about 47 000 species.**

**HANDOUT- INVERTEBRATE Vs. VERTEBRATE CHART**
**SEE PAGE 448 OF NELSON BIOLOGY 11**

PRE-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson**
**Biology 11**

# ACTIVITY 2

**Time:**
35 minutes

**Objective:**
To introduce the Classification System and to show how humans fit into the Classification System. This introduces the idea of phylogeny and of evolution..

**Materials for Teacher:**
- 8 copies of the classification chart handout – see appendices pg. 18
- 8 glue sticks
- 8 pieces of chart paper
- 8 gifts – candy bars, etc

**Materials for Students:**
- Paper
- Pen/Pencil

**Matching Game:**
1. Before class begins, cut the classification chart and table above so that all categories (including arrows) are separated, ensuring that there are 8 piles with the same information provided in each pile. You may want to blow up the handout onto bigger paper.

2. Divide the class into groups of 4.

3. Distribute one pile per group.

4. Ask them to try and correctly match the pieces together into the same cohesive chart that was cut up. The team that does it correctly gets the prize. The idea of classification and the way it works should have already been introduced in the previous activity, but you may feel that your class may need some guidance. If so, provide the following on the board:

**CHALKBOARD**

Classification of Living Things

| | | |
|---|---|---|
| Domain | largest | Bacteria, Archaea, Eucarya |
| Kingdom | ↓ | All vertebrates and invertebrates belong to the Kingdom Animalia |
| Phylum | ↓ | similar Phyla are grouped into a Kingdom |
| Class | ↓ | similar Classes are grouped into a Phylum |
| Order | ↓ | similar Orders are grouped into a Class |
| Family | ↓ | similar Families are grouped into an Order |
| Genus | ↓ | similar Genera are grouped into a Family |
| Species | smallest | similar Species are grouped into a Genus |

**Grade 11- Biodiversity**

## CLASSIFCATION CHART HANDOUT

**Carl Linnaeus (1707-1778)**

Creator of our present biological system of classification. His system is based on an organism's physical and structural features and operated on the idea that the more features organisms have in common, the closer they are related.

### Binomial Nomenclature

A scientific method of naming organisms based on Latin and sometimes-Greek language. This method is based on a two-name system by using the Genus and Species of a particular organism. The name is often based on certain characteristics belonging to the organism. This two-name system has an added advantage by indicating similarities in anatomy and also by keeping it in this scientific language it can be understood world-wide.

### Rules of Binomial Nomenclature

Genus – Always capitalized
Species – Never capitalized
Both words must be underlined separately or italicized
i.e., *Ursus horribilis* or Ursus horribilis (Grizzly Bear)

**Species**

A group of organisms that look alike and can interbreed under natural conditions to produce fertile offspring.

## Grade 11- Biodiversity

Domain: Eucarya
cells with clearly defined nucleus
Kingdom: Animalia
multicellular, heterotrophic (must eat food to get energy), generally reproduce sexually, live in terrestrial and aquatic habitats

↓

Phylum: Chordata
presence of a notochord at some point in life of species

↓

Class: Mammalia
warm blooded, nurses babies

↓

Order: Primata
Mainly arboreal although some are terrestrial, complex social organizations, long infancy dependency periods with bearing of single offspring, hands are prehensile (can grasp) and have opposable thumbs; tactile pads and nails on fingers and toes. Eyes have binocular and color vision. Face has large eyes and brain and a reduced snout area. Examples of animals found in this category are gorillas, chimpanzees, gibbons and humans.

↓

**Superfamily: Hominoidea**
molar teeth, absence of tail, arms longer than legs (except in humans), orthograde (semi-erect) posture.

**Family Hylobatidae**
arboreal, live in small groups and male-female pairs bond for life

↓

*Hylobates lar*
*(*white-handed gibbon)

**Family Pongidae & Family Hominidae**
*(Some primatologists have united these as one Family called Hominidae)*
tree and ground dwellers
bipedal (fully erect, shortening of arms, reduced canines, larger brain, longer thumb, flatter muzzle

*Pongo pygmaeus* (orangutans)

*Gorilla gorilla*
(gorilla)

*Pan troglodytes*
(chimpanzee)

*Pan paniscus*
(bonobo or pygmychimp)

*Homo sapiens*
(man)

The Variety of Life, by Colin Tudge
*Oxford University Press 2000*

PRE-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson Biology 11**

# ACTIVITY 3

**Time:**
35 minutes

**Objective:**
To teach students the purpose and methods by which one designs and reads a dichotomous key.

**Materials for Teacher:**
- 6-10 student volunteers
- graph paper or chalkboard
- chalk or markers

**Materials for Student:**
- Pen/Pencil
- Paper

**The Dichotomous Key:**
1. Get 6-10 kids to volunteer to participate in this activity.

2. Pair the rest of the students up.

3. Have the students' try to separate out each volunteer based on something that is individual about them (only related to clothing).

4. Each pair gets a turn to state their idea. This ensures full participation.

5. The teacher can help by acting as mediator or by helping to start it off. For example: breaking up the group by those who wear pants and those who don't wear pants. Then the class should be able to take it from there with the teacher's help.

6. The teacher (or student) can continue to write the methods by which the students are choosing to separate the volunteers (e.g., only wearing pants, only wearing skirts, has glasses, etc) on the board or on graph paper.

7. Once the class has successfully separated out each individual within the 6 volunteers, a key can be written with the help of the teacher on the chalkboard. See next page for example.

PRE-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson Biology 11**

**ACTIVITY 3 CONTINUED**

**Example:**

According to clothes

1. wearing pants…go to 2
   wearing skirts…go to 3

2. black, brown, blue pants…..go to 4
   white pants……Peter Cunnings

3. above knee……Stephanie Peters
   below knee……Kyle Roberts

4. black, brown, blue with sandals…….go to 5
   black with heels……...Lauretta Jay

5. Brown with Sandals……Lenna Gray
   Blue, Black with Sandals…….go to 6

6. Blue with Sandals……Mark Porter
   Black with Sandals……..Jimmy Marshall

**Note: There is a possibility that this activity could be offensive to some people when played in the wrong way (i.e. according to race, size, etc) so it is recommended that the game is played only with clothes or something else of a non-offensive nature. You must be comfortable that your students will treat this activity and the people involved in a mature manner. It is suggested that you do not allow your students to use certain adjectives that may be offensive (i.e. ugly shirt, boring shoes, nerdy glasses, etc), or limit them to using only color adjectives (i.e. blue shirt, red top, etc)**

**Grade 11- Biodiversity**

## TORONTO ZOO ACTIVITY

**Purpose:**
To allow the students to visit the zoo and learn about the physiological and anatomical adaptations of the organisms in the Animal Kingdom, as well as to prepare the students for the post-zoo activity.

**Curriculum Connection:**
- Define the fundamental principles of taxonomy and phylogeny, and to explain how species are categorized and named according to structure and/or evolutionary history
- Describe selected anatomical and physiological characteristics of representative organisms from each life kingdom.
- Compare and contrast the life cycles of representative organisms from the Animal Kingdom.

# Activity 1

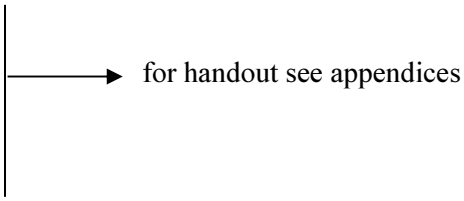
**Time:**
60 minutes

**Objective:**
To understand structural and physiological differences in adaptation between selected organisms.

**MATERIALS FOR TEACHER:**
- Enough copies of handout for students – see appendices pgs. 22-29
- Exemplar as reference – see appendices pg. 30
- Extra pens/pencils and paper
- Rubric – see appendices (rubric is for both activity 1 and activity 2) pg. 37

**STUDENTS:**
- Pens/Pencils
- Paper and Clipboard

**Adaptation Activity:**
1. Each student must pick an adaptation that he she would like to focus on.
2. They must fill in handout. They must compare at least 3 organisms.
3. The topics to choose from are:
   Beaks and Birds (page 462)
   Feet and Adaptation (page 470)
   Ears and Adaptation
   Covering and Adaptation



# Appendix 1

## HANDOUT -ZOO ACTIVITY 1

## TO PECK OR NOT TO PECK? THAT IS THE QUESTION!

**You are a famous researcher, studying variation of beaks in birds. Since you have heard so many wonderful things about the Toronto Zoo, you have decided to come and take a look at the bird species living at the Zoo. You only have a short amount of time before you have to fly off to Australia to continue your research. You are only able to look at 3 birds, each of them being from a different pavilion. You have developed the following chart to keep your notes organized and you excitedly fill in as much of it as possible and you hypothesize where necessary.**

## Handout Activity - 1

| Birds and Beak Adaptation | | | | |
|---|---|---|---|---|
| **Animal Name (Common & Scientific)** | **Pavilion or Zoogeographic area** | **Geographical location and features specific to the location (Look at setup of pavilion for the answers – is it hot? Lots of vegetation? Tropical? )** | **Information about the beak (e.g., Colour? Curved? Straight? Pointy? Long? Short? Thin? Thick? Other unique features? etc)** | **Ecological role of beak (What purpose does this type of beak serve for the bird?)** |
| | | | | |
| | | | | |
| | | | | |

# HANDOUT -ZOO ACTIVITY 1

# TO COVER OR NOT TO COVER? THAT IS THE QUESTION!

**You are a famous researcher, studying variation in the outer covering of animals. Since you have heard so many wonderful things about the Toronto Zoo, you have decided to come and take a look at the animals living at the Zoo. You only have a short time before you have to fly off to Australia to continue your research with Steve Irwin, the 'Crocodile Hunter'. You are only able to look at 3 animals, each of them being from a different pavilion. You have developed the following chart to keep your notes organized and you excitedly fill in as much of it as possible and you hypothesize where necessary.**

# HANDOUT -ZOO ACTIVITY 1 - CHART

| Covering and Adaptation | | | | |
|---|---|---|---|---|
| **Animal Name (Common & Scientific)** | **Pavilion or Zoogeographic Area** | **Geographical location and features specific to the location (Look at setup of pavilion for the answers – is it hot? Lots of vegetation? Tropical? )** | **Information about the outer-covering (Thick? Hard? Scaly? Furry? Bare-Skinned? Colour?, etc)** | **Ecological role of (What purpose does this outer-covering serve the animal?)** |
| | | | | |
| | | | | |
| | | | | |

# HANDOUT -ZOO ACTIVITY 1

## TO EAR OR NOT TO EAR? THAT IS THE QUESTION!

**You are a famous researcher, studying variation in animal ears. Since you have heard so many wonderful things about the Toronto Zoo, you have decided to come and take a look at the animals living at the Zoo. You only have a short time before you have to fly off to Australia to continue your research with Steve Irwin, the Crocodile Hunter. You are only able to look at 3 animals, each of them being from a different pavilion. You have developed the following chart to keep your notes organized and you excitedly fill in as much of it as possible, and you hypothesize where necessary.**

# HANDOUT -ZOO ACTIVITY 1 - CHART

| Ears and Adaptation | | | | |
|---|---|---|---|---|
| **Animal Name (Common & Scientific)** | **Pavilion or Zoogeographic Area** | **Geographical location and features specific to the location (Look at setup of pavilion for the answers – is it hot? Lots of vegetation? Tropical? )** | **Information about the ear (e.g., Placement? Size? Shape? Color? Movement of Ear? Any other unique features?)** | **Ecological role of ear (What purpose does this type of ear serve the animal?)** |
| | | | | |
| | | | | |
| | | | | |

# HANDOUT -ZOO ACTIVITY 1

## DIFFERENT WAYS OF SAYING THE SAME THING?…OR NOT?

**You are a famous researcher, studying variation of feet in mammals. Since you have heard so many wonderful things about the Toronto Zoo, you have decided to come and take a look at the mammal species living at the Zoo. You only have a short time before you have to fly off to Australia to continue your research. You are only able to look at 3 mammals, each of them being from a different pavilion. You have developed the following chart to keep your notes organized and you excitedly fill in as much of it as possible and hypothesize where necessary.**

# HANDOUT -ZOO ACTIVITY 1 - CHART

| Feet and Adaptation in Mammals | | | | |
|---|---|---|---|---|
| **Animal Name (Common & Scientific)** | **Pavilion or Zoogeographic Area** | **Geographical location and features specific to the location (Look at setup of pavilion for the answers – is it hot? Lots of vegetation? Tropical? )** | **Information about the feet (e.g., Unguligrade? Digitigrade? Plantigrade? Hairy? Big?, etc)** | **Ecological role of the foot (What purpose does this type of foot serve the mammal?)** |
| | | | | |
| | | | | |
| | | | | |

**Unguligrade:** **The running is accomplished on the tips of the toes, which are covered by hooves (horse).**
**Digitigrade:** **The heels are raised off the ground, and walking occurs using the digits (cat).**
**Plantigrade:** **Whole foot is placed on ground (human).**

# EXEMPLAR:ZOO ACTIVITY 1
# TO PECK OR NOT TO PECK? THAT IS THE QUESTION!

| Birds and Beak Adaptation | | | | |
|---|---|---|---|---|
| **Bird Name (Common & Scientific)** | **Pavilion or Zoogeographic Area** | **Geographical features specific to the pavilion (i.e. tropical? Arid? Lots of vegetation?, etc)** | **Information about the beak (e.g., colour? Curved? Straight? Pointy? Long? Short? Thin? Thick? Other unique features?)** | **Ecological role of beak (What purpose does this type of beak serve for the bird?)** |
| **Concave Casqued Hornbill**<br><br>*Buceros bicornis* | **Indo Malaya** | **Dense vegetation, Humid Tropical** | **Large bill<br>Casqued<br>Brightly coloured casque filled with sponge tissue<br>Pointy<br>Curved (hill-like)<br>Cutting edge of beak is 'toothed'** | **Large beak to reach for food. Pointy and curved with tooth for tearing. Color shows attractiveness for mating purposes. Casque said to be used as a sign of virility, and age.** |
| **Great Horned Owl**<br><br>*Bubo virginianus virginianus* | **Americas** | **Varies<br>Humid to dry<br>Vegetation present** | **Hooked downward<br>Relatively small<br>Dark colored beak** | **Small and hooked downward to reduce obstruction of owl's eyes. Hooked for tearing.** |
| **Australian Magpie**<br><br>*Gymnorhina tibicen* | **Australasia** | **Eucalyptus woodlands near open spaces** | **Strong, straight chisel like beak, darker at the tip** | **Strong general purpose beak for foraging on the ground for insects and worms.** |

**Page numbers correlate with information provided in Nelson Biology 11**

# Activity 2

**Time:**
60 minutes

**Objective:**
To focus on an organism from the Animal Kingdom and learn about its physiological and anatomical adaptations, which will then be compared and contrasted in the post-zoo activity.

**Materials for Teacher:**
- Enough Handouts for Students - See Appendices pgs. 32-34
- Extra pencils/pens and paper
- Exemplar – See appendices pg. 35-36
- Rubric – see appendices (rubric is for both activity 1 and activity 2) pg. 37

**Materials for Students:**
- Pens/Pencils
- Paper
- Clipboard

**Compare/Contrast Activity:**
1. Place students in groups of six.
2. In their groups, each student is responsible for selecting one of the 5 vertebrate classes or the invertebrate category. There should be no overlap.
3. Then once the students have made their selections, each student is responsible for filling out the handout based on the organism they chose.
4. The only stipulation is that the organism must be a representative of the class they selected as their focus.

**Note:**
Due to the nature of the zoo, animals may go on or off display at anytime. Also, students will not know the answers to many of the questions, but their job is to act as researcher and try to hypothesize. Many species do have information boards located at the display and you can also have questions answered at the Zoo Keepers' presentations (see map in Visitors Guide for times). For information searches on the Internet it is usually best to use the animal's two part scientific name in a search engine.

## Handout Zoo Activity 2

# Getting to the Nitty Gritty

As part of your research, you are studying classification and think you are hot on the trail of some new information that will blow the scientific community away. In order for you to continue this research, you have developed a chart to study the anatomical and physiological characteristics of the animal you feel will most aid your study. After discussing with your 5 other scientific colleagues, you will choose one Class of the Animal Kingdom and focus on any animal at the zoo that belongs to the Class you have chosen…Don't worry, your colleagues will cover the other animal classes!
Part of being a researcher involves observation and hypothesis. Most exhibits have information on signs and plaques, so….Read! Read! Read!
Observe as much of your chosen animal as possible and hypothesize where necessary, as you will not find all the information you are looking for at the exhibits. In order to learn more, attend the Meet the Zookeeper presentation on the animal you are observing (look at map in Visitors Guide for times) and ask lots of questions!

## HANDOUT ZOO ACTIVITY 2

| | | |
|---|---|---|
| **Class** | | |
| **Animal** | **Common Name:** **Scientific Name:** | |
| **Pavilion or Zoogeographic Region** | | |
| **Presence of bony skeleton?** | | |
| **Warm or Cold Blooded?** | | |
| **Estimated Weight and Length** | | **Importance of this trait(s):** |
| **Presence of Tail? If so, describe appearance** | | **Importance of this trait(s):** |
| **Outer body coverage (note color, and patterning as well)** | | **Importance of this trait(s):** |
| **Eyes (location, presence of eyelids, etc)** | | **Importance of this trait(s):** |
| **Teeth (Type of teeth animal has)** | | **Importance of this trait(s):** |
| **How does it move?** | | **Importance of this trait(s):** |
| **What does it eat?** | | **Importance of this trait(s):** |
| **Viviparous or Oviparous?** | | |
| **Reproductive Cycle?** | | |
| **Longevity or lifespan?** | | |
| **Key behavioral traits** | | |
| **What is a key issue to the downfall of these species?** | | |
| **How does the exhibit meet the animals needs?** | | |

## HANDOUT ZOO ACTIVITY 2

**ANY OTHER PHYSICAL OR BEHAVIORAL CHARACTERISTICS (feel free to draw)**

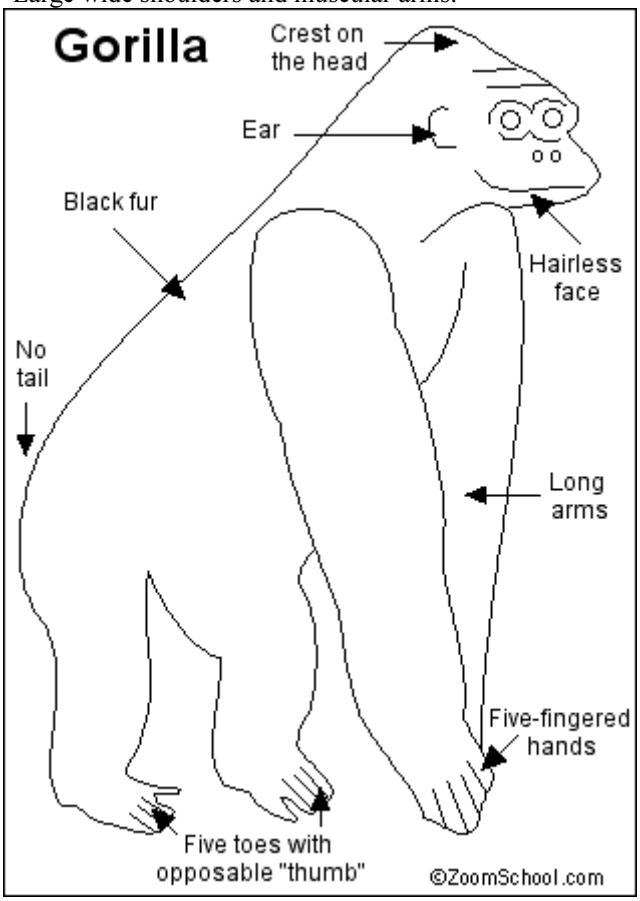
## Grade 11- Biodiversity

**EXEMPLAR: HANDOUT ZOO ACTIVITY 2** **BIODIVERSITY** **GRADE 11U**

| | | |
|---|---|---|
| **Class:** Mammalia | | |
| **Animal** | **Common Name:** Gorilla **Scientific Name:** *Gorilla gorilla* | |
| **Pavilion or Zoogeographic Region** | Africa | |
| **Geographic location and features (Look at pavilion setup, e.g. Vegetation? Arid?, etc)** | Dense vegetation<br>Humid<br>Tropical) | |
| **Presence of bony skeleton?** | Has vertebrae | |
| **Presence of Tail?** | No | |
| **Estimated Weight and Length** | Males – 300 lb., 175 cm<br>Females – 200 lb., 152 cm | **Importance of this trait(s):**<br>Variation in sizes between sexes illustrate importance of dominance. |
| **Outer body coverage (note color, and patterning as well)** | Medium length fur; is black, silver and reddish with black skin underneath<br>Adult males have a silver coloring on back. No fur on armpits, fingers, palms and bottom of feet. | **Importance of this trait(s):** Fur keeps animal warm and waterproof. No fur on bottom of feet and hands for tactile sensation and grasping. |
| **Eyes (location, presence of eyelids, etc)** | 2 eyes located in front of head<br>has eyelids<br>wide set<br>focus closer than humans | **Importance of this trait(s):** eyes are looking forward for good stereoscopic vision, as in all primates, this aids in finding and examining food and climbing in trees. Eyelids are for protection |
| **Teeth (Type of teeth animal has)** | Teeth similar to humans, but larger and more robust. Males have large canine teeth. Large powerful jaws with muscles anchored in a large crest in the male. | **Importance of this trait(s):** Large molar teeth (like ours) used for chewing coarse vegetation. Canine teeth used for fighting and display |
| **Other Adaptations?** | Opposable toes and thumb | **Importance of this trait(s):** Used for grasping and climbing |
| **How does it move?** | Quadruple mainly and bipedal over short distances. Knuckle walk with forelimbs and flat-footed or plantigrade with hind limbs. | **Importance of this trait(s):** Gorilla not fully erect yet, like humans, but could use bipedal motion to see above vegetation or express dominance. Are capable of quick burst of speed over short distances. |
| **What does it eat?** | Almost exclusively vegetarian. Preferred food is fruit, plant stems, vines and leaves. | **Importance of this trait(s):** Need to eat a lot in order to maintain body energy. Need to seek mineral supplements like most other herbivores. |
| **Viviparous or Oviparous?** | Viviparous | |
| **Reproductive Cycle?** | Females reach maturation at 8-10 years of age and males reach maturation at 12-15 years of age. Females have menstrual cycle like humans, being 30-31 days and average gestation period is 265 days. A single young is born weighing about 3 pounds and depends on mother for food and protection and stays with mom for first 3 years. | |
| **Longevity (life span)?** | Average of 40-45 years | |
| **Key behavioral traits** | Live in fairly stable groups of 5-15 individuals. Larger groups consist of an adult male, sever younger males and a larger number of females and their young. Smaller groups may consist of 1 adult male with a few females and their young. They are diurnal, nest in trees or on the ground. They are quiet most of time, dozing and sunbathing. Postures, gestures, facial expressions, clapping, chest drumming and vocalizations are used in to communicate with each other | |
| **What is a key issue to the downfall of these species?** | Endangered – 10,000 western lowland gorillas in wild, Mountain gorillas are in immediate danger of extinction with only 400-600 still surviving. The Gorilla's chief enemy is man destroying its habitat and collecting young sale. The most immediate threat is that gorilla meat is a primary item of the bush meat trade. | |
| **How does the exhibit meet the animals needs?** | 2 areas: Nighttime sleeping area and large day area. The nighttime sleeping area is bedded and contains lots of bars for the gorillas to play on. There are several windows for the humans and gorillas to look at each other. The open day area is a larger and open with lots of climbing structures and resting areas. | |

**ANY OTHER PHYSICAL OR BEHAVIORAL CHARACTERISTICS: (Please feel free to draw)**

-Vocal apparatus is not made for speech.
-Vocalize from throat and produce sounds rather than words.
-Hooting sound is usually prelude drumming display.
-Gorillas roars, growl, bark, grunt , purr, croak, hoot, screech.
-Have deep brows
-Large wide shoulders and muscular arms.



**Grade 11- Biodiversity**

**TORONTO ZOO ACTIVITY ASSESSMENT TOOL**

# RUBRIC

| DESCRIPTION | LEVEL 1 | LEVEL 2 | LEVEL 3 | LEVEL 4 |
|---|---|---|---|---|
| **PRESENTATION** | -Writing is incomprehensible<br>-Over 5 spelling errors have been made | -Writing is difficult to read<br>-5 or less spelling errors have been made | -Writing is legible, and neat<br>-3 or less spelling errors have been made | -Writing is very neat and very legible<br>-All spelling is correct |
| **PARTICIPATION** | -Student was absent for more than one part of the zoo field trip<br>-Student was late for more than one of the required meetings throughout the day<br>-Student made no effort to communicate with group and/or participate in activities | -Student was absent for one part of the zoo field trip<br>-Student was late for 1 of the required meetings throughout the day<br>-Student had some difficulties in communicating with group or participating in activities | - If student was in attendance for zoo field trip, grade at level 4<br>-Student was on time for all required meetings throughout the day<br>-Student communicated well in group and participated in the activities. | -Student was in attendance for zoo field trip<br>-Student was on time and even early for all required meetings throughout the day<br>-Student communicated well in group and participated in the activities, helping others were possible |
| **CONTENT** | -4 or more categories are not completed<br>-3 or more errors were made in following directions<br>-4 or more categories had less than 3 observations (except pavilion)<br>-content has many minor and major errors<br>-Where applicable, many of the hypotheses were unclear and did not relate to subject matter. | -3 categories are not completed<br>-2 errors were made in following directions<br>-3 categories had lass than 3 observations (except pavilion)<br>-content is not always correct with 1 major error<br>-Where applicable, student made effort to hypothesize but was not always clearly related to subject matter | -1 category is not completed<br>-1 error was made in following directions<br>-2 categories had less than 3 observations (except pavilion)<br>-content is almost always correct with no major errors<br>-Where applicable, hypothesis made sense and related to subject matter | -All categories are completed<br>-Directions were specifically followed<br>- 3 observations have been made for each category (except pavilion)<br>-Content is correct with no errors<br>-Where applicable, hypotheses made perfect sense and clearly related to subject matter showing exemplary insight |

## POST-ZOO ACTIVITY

**Purpose**:
**To continue to show students' the importance of adaptation and classification systems, as well as bring in the value of "chain of life" and "food web." This may provide a good connection for introduction to other life kingdoms and viruses.**

**Curriculum Connection**:
- Define the fundamental principles of taxonomy and phylogeny.
- Describe selected anatomical and physiological characteristics of representative organisms from each life kingdom.
- Demonstrate through applying classification techniques and terminology, the usefulness of the system of scientific nomenclature in the field of taxonomy.
- Classify representative organisms from each of the kingdoms.
- Demonstrate an understanding of connection between biodiversity and species survival.

**Note: Several activities are suggested.**

POST-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson**
**Biology 11**

## ACTIVITY 1

**Time:**
75 minutes or longer

Objective:
To compare and contrast each of the classes in the animal kingdom and create a dichotomous key to differentiate the species and classes studied.

**Materials for Teacher:**
- At least 6 pieces of chart paper
- Markers
- Extra handouts
- Exemplar handout of dichotomous key

**Materials for Students:**
Their notes from the Zoo and Pre-Zoo activity

**Designing of a classification key:**
1. Have the students get into the groups of six . These groups should be specific, in that all the students who studied a particular class in the zoo activity should be together (e.g., all students who researched an animal in the Aves Class, should be grouped together, etc).
2. Using the notes that they made the pre- zoo day, they are required to develop a dichotomous key, that separates each Class in the Animal Kingdom as well as the invertebrate category (for purpose of activity, the informal invertebrate category can be treated as a Class.
3. Since this is a large task, it might help students to break up the task, by noting key differences and similarities between classes.
4. This key should be simple – see exemplar pg.41
5. The next step is to make a key based on the actual selected organisms. Genus and Species name must be used when differentiating between organisms.
6. In order to effectively compare/contrast each Class, they must use at least 4 of the categories in the hand out. Of the 4 categories, the reproductive cycle is a must.
7. This is a rather daunting task, so it may help to give students the following tips:
   - Have each student within the group note important or special features that may be key to the organism they studied.
   - Break the group into threesomes and have each subgroup note the key similarities and differences between each of their selected organisms.
   - Bring the two subgroups together and do the same thing
   - Now they should be ready to begin the key. Starting with the key similarities tends to be easier.

## POST-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson Biology 11**

### ACTIVITY 1 CONTINUED

**Note: Even though students have already developed a key based on classes, they may have a tendency to use the information from the "class" key in the "genus/species" key. Official classification keys are broken down according to the different taxons (e.g., first identify the kingdom using the kingdom key, then identify the phylum using the phylum key, then identify the class using the class key, etc) and this is what the students are also doing in a simplified manner. Because of these separations, it is important that there is no overlap between these different keys, as this gives students an idea of how "official" keys are actually written and used to identify species.**

POST-ZOO ACTIVITY 1

## EXEMPLAR – DICHOTOMOUS KEY OF ANIMAL CLASSES

1. Warm blooded……go to 5
   Cold blooded……..go to 2

2. Have bony (sometimes cartilaginous skeleton)……go to 3
   Do not have backbone……Invertebrates (for purpose of activity, calling "invertebrates" a class)

3. Found only in freshwater areas around world…….Amphibia
   Not only found in freshwater areas around world…..go to 4

4. Found in both freshwater and saltwater areas around the world…….Fish (for purpose of activity, calling "fish" a class)
   Found in a wide variety of habitats including tropical, subtropical and arid regions…..Reptilia

5. Have feathers…….Aves
   Do not have feathers……go to 6

6. Nurse young with mammary glands……Mammalia

POST-ZOO ACTIVITY

**Page numbers correlate with information provided in Nelson Biology 11**

## ACTIVITY 2

**Time:**
1-2 periods (150 minutes)

**Objective:**
To allow students to take knowledge learned in the zoo activity an apply it to endangered species within Ontario.

**Materials for teacher:**
- Website: http://www.rom.on.ca/ontario/
  You will find a list of regions and endangered species in Ontario at this site.
- Possibly computer lab with Internet for Student Research

**Materials for Students:**
- Notes from Pre-Zoo and Zoo Activity

**Bringing it Back to Ontario:**
1. Have students pick an endangered species in Ontario to Study
2. Have them study the physiological and anatomical adaptations of their chosen animal.
3. Have students suggest its effect on other animals and all other kingdoms by designing a "web of life" around their animal of choice.
4. This provides a good link into learning more about the other kingdoms.

**Other possible extensions:**
- Design an animal – see page 447 in Nelson
- Design an exhibit for an animal – see: Project Wild., *Polar Bears in Winnipeg.,* Canadian Wildlife Federation., Pages 145-147.

# REFERENCES

1. **Primack, R.** 1993. Essentials of Conservation Biology, Sinnauer Associates Inc., Massachusetts.

2. **Ritter, Bob, Adam-Car Christine, Fraser Douglas.** 2002. Nelson Biology 11, Nelson Thomas Learning., Toronto.

3. *Project Wild. Polar Bears in Winnipeg. Canadian Wildlife Federation., Page 145.

4. **Tudge, Colin.** 2000, The Variety of Life, Oxford University Press, New York. pp. 684 .

*For more information on this book contact Canadian Wildlife Federation, as they distribute these books in their workshops. There is no publication date or editor written on the book.

**Grade 11- Biodiversity**

Student Activity Evaluation Form

Please let us know how useful you found these activities. When you return a completed evaluation to us we will send you an attractive poster about gorilla reproduction and endocrinology. *Please return to:*

**Education, Toronto Zoo**
**361 A Old Finch Ave.**
**Toronto, ON M1B 5K7**
**FAX: 416-392-5948**

Date: _____ Grade Level: _____,

Subject:_____, Your Name: _____,

School:_____,

**Please rate the following on a scale of 1 to 5 : 1 poor; 2 fair; 3 satisfactory, 4 good, 5 excellent**

1. The activities were appropriate for the curriculum. 1 2 3 4 5

2. The language level was suitable for your students. 1 2 3 4 5

3. The tasks were clearly explained and easily understood by the students. 1 2 3 4 5

4. Did you use this activity as part of your evaluation process for students? (Y / N)

5. Did you or will you be visiting the Toronto Zoo with yours students? (Y / N)

6. Would you use these activities again? (Y / N)

7. How would you change the activity to be more useful?

8. Did you use any other Zoo teaching resource material? (Y / N) (What?)

9. Are there any other kinds of resources you would like the Zoo to provide to support your visit?

10. Do you have any other comment?