

## DEFINING THE ORDER PRIMATES

Humans belong to the zoological Order *Primates*, which is one of the 18 Orders of the Class *Mammalia*. Today we will review some of the characteristics that distinguish primates from other mammals and learn about who's who in our noble Order.

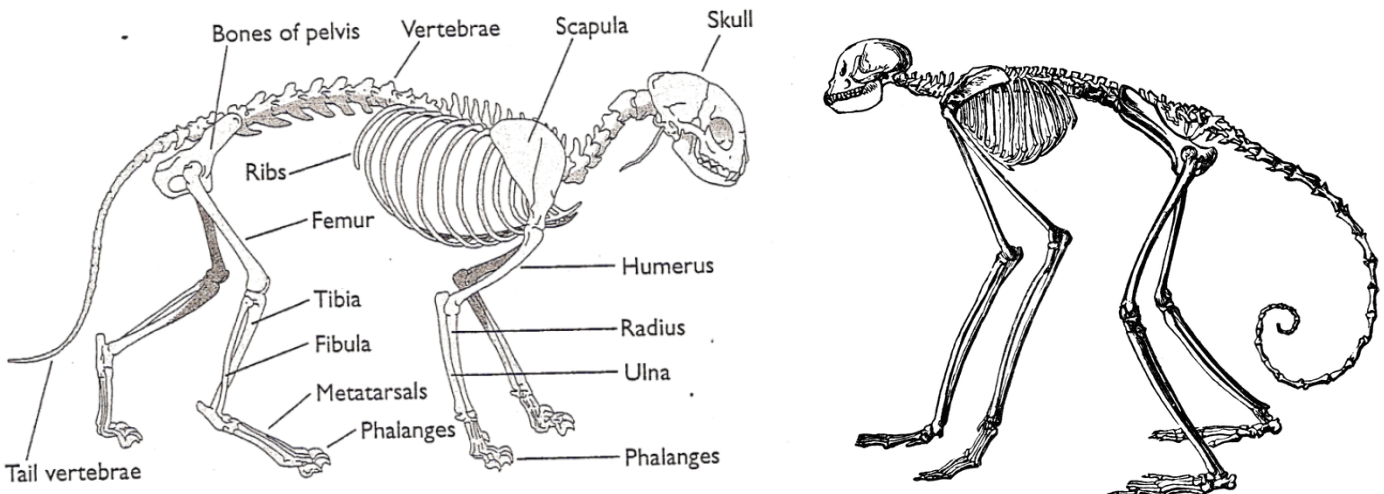
### **PART ONE: What is a primate?: Trait comparisons between mammals and primate.**

The traits you'll be examining in this lab are those that have traditionally served to distinguish primates from other mammals. For example, in a typical quadrupedal mammal such as a horse, the clavicle (collarbone) is absent as there is very little lateral movement of the forelimbs. Some traits, however, are not readily visible in the skeleton (e.g., nails instead of claws). All of these characteristics, however, can be related to one particular life-style that was peculiar to the ancestor of all living primates and is typical of most primates today---moving around through the trees by grasping with the feet and hands.

The common ancestor of all living primates was an arboreal (tree-living) climber with prehensile extremities that probably relied on its eyes more than its sense of smell. This ancestor may have had some depth perception made possible by over-lapping visual fields of the forwardly rotated eyes. This primate ancestor retained two traits (pentadactyly and a clavicle) from the early mammalian condition that have been lost in many other mammal groups. Both characteristics proved essential for moving arboreally.

Several significant anatomical features of the primate cranium help us distinguish primates from other mammals. The mammalian trend toward increased brain development has been further emphasized in primates, as shown by a relatively enlarged braincase. In addition, the primate emphasis on vision is reflected in generally large eye sockets. The reduction of the snout and corresponding flattening of the face indicate a decreased dependence on olfaction. Enhanced protection for the eyes is evidenced by the eye sockets being enclosed at the sides by a ring of bone called the *postorbital bar*. In most other mammals, there is no postorbital bar. In addition, in anthropoids and tarsiers, there is a plate of bone at the back of the eye orbit called the *postorbital plate*. The postorbital plate is not present in prosimians.

First, look at the anatomical features listed in the illustration below and use this as a guide for identifying those same features on the monkey skeleton.



At the lab table, you'll find the skulls of a domestic cat and an old world monkey. Now, think about what you know from your association with cats and how the traits associated with primates reflect their adaptation to an arboreal lifestyle to help you come to some conclusions in comparing the cat and the monkey in the specific traits listed below.

## **TRAITS OF PRIMATES**

### **1. Reduced snout**

Describe how far in front of the braincase the snout sticks out for the cat and the monkey.

What is it about their activity patterns and lifestyle do you think explains the difference(s) between the two? Remember, cats in the wild are predators.

### **2. Orientation of eyes**

Viewing the skulls directly from the front, describe the orientation (placement in skull) of the eyes of the cat and the monkey.

Why is the 3-D, binocular vision made possible by the forward facing eyes of the monkey advantageous to primates? Why is this feature not as important for cats? (hint: this relates to what you observed in the feature above)

### **3. Enclosed/Protected eye sockets**

Are the eye sockets of the cat enclosed by a ring of bone (*the postorbital bar*) and enclosed by bone at the back of the socket (*the postorbital plate*)? Yes No

Are the eye sockets of the monkey enclosed and protected? Yes No

Why do you think the eyes of the monkey have more skeletal protection than that of the cat?

**4. Clavicle (collarbone)** – The clavicle positions the arms away from the body which helps to support the upright posture adopted by the primates. This also provides the arm with more flexibility and range of motion.

Referring to the illustration of the cat skeleton, does the cat have a clavicle (collarbone)? Yes No

Does the monkey have a clavicle? Yes No

What is it about the monkey's activity patterns and lifestyle that make having a clavicle important or advantageous? (Refer to the cover sheet re: horse's lack of clavicle, and Our Primate Relatives reading)

#### **5. Prehensile (grasping) hands and feet**

Although this feature cannot be "seen" in the skeleton, it is a distinguishing trait for primates. Use your knowledge and familiarity with cats to answer the following questions.

Does the cat have prehensile hands and feet? Yes No

Does the monkey have prehensile hands and feet? Yes No

What is it about the activity patterns and lifestyle of the cat and monkey do you think explains the difference(s) between the two?

#### **6. Opposable thumb**

Do cats have an opposable thumb? Yes No

Do monkeys have an opposable thumb? Yes No

Based on your reading (Our Primate Relatives) and notes from class, what types of activities are made more efficient and effective by the opposable thumb of the monkey? Explain why we don't see this adaptation in cats.

#### **7. Generalized dentition**

Refer to the hand out at the lab table "Primate Diet and Dentition" to answer the questions that follow.

Describe the size and shape of the teeth of the cat, paying close attention to the canines.

Describe the size and shape of the teeth of the monkey, paying close attention to the canines.

The cat has specialized dentition (teeth are designed for specific function). What do the teeth of the cat and the monkey tell you about the diet of each of these animals?

Why is generalized dentition (variety of teeth that are not specialized for one function) an advantage for primates?

Referring to the other mammal skulls at the table (the deer and the wolf), describe the dental pattern and relate to dietary pattern.

Deer – Does the deer have specialized or generalized dentition? Explain how this relates to diet.

Wolf – Does the wolf have specialized or generalized dentition? Explain how this relates to diet.

### **8. Relatively large brain in relation to body size**

For comparative purposes, you will include observations of two additional mammalian species, a deer and a wolf. To gain an appreciation for the difference in relative brain sizes between a primate and other mammalian species, look closely *at the size of the braincase in relation to the overall size of the skull, including the face*. Describe the condition for each below:

Deer –

Wolf –

Cat –

Monkey –

The relatively large brains of primates enable a lot more complex behaviors, including increased intelligence and sociality. Based on what you have read and have learned so far about primate behavior, discuss with your group some of the behaviors in which primates engage that reflect the evolution of this characteristic and list them below.

## **PART TWO: Cranial Anatomy and Comparisons**

The Primate Order is defined by a set of evolutionary trends that are important for understanding human evolutionary anatomy and behavior. Although we are looking only at skulls and cranial features, these features shed light on some of the significant changes that led to the human lineage.

### **Instructions**

Go to the lab table where a number of primate skulls have been laid out. For each set of skulls, compare the selected primate species in terms of the cranial/dental features listed and then answer the questions that follow based on your observations. Use the handout at the lab table “Anatomical features” as a reference for any cranial or dental features listed. Below are some terms you should find useful in completing your descriptions.

### **Helpful descriptors:**

Robust – very thick, heavy

Protruding or Prognathic – sticking or jutting out

Prominent – very noticeable

Faint – not very noticeable

***THE PROSIMIANS:*** *Prosimians are the most ancestral of the primate species. This means that they have retained some features from the mammalian ancestor from which they evolved. These skeletal features reflect their activity patterns which also differ from the higher primates, or Anthropoids. Many prosimians are nocturnal, lack color vision, have claws instead of nails, are mostly insectivorous (although there is a great deal of variation among the lemurs), and have a different dental pattern. The skulls at this table are of a ring-tailed lemur, a loris, and a tarsier.*

### **1. Describe the size of the skull (in relation to ALL of the skulls at the lab table) and the size of the braincase in relation to the overall size of the skull:**

#### Size of skull

#### Size of braincase in relation to overall size of skull

Lemur –

Loris –

Tarsier -

### **2. Describe the orientation (forward facing or on the side) and size of the eyes.**

Lemur –

Loris -

Tarsier –

**3. Are the eyes protected by a postorbital bar and plate? (Indicate Yes or No)**

**Postorbital Bar**

**Postorbital Plate**

Lemur -

Loris -

Tarsier -

**4. Describe the prominence of the snout (degree of prognathism – how far the snout sticks out in front of the braincase):**

Lemur -

Loris -

Tarsier -

**5. Describe the teeth and whether or not each species has a dental comb :**

Lemur -

Loris -

Tarsier -

**6. Describe the position of the foramen magnum**

Lemur -

Loris -

Tarsier -

***NOTE: The position of the foramen magnum on the tarsier is due to its upright, vertical leaping locomotive pattern. They are not bipedal.***

**THE ANTHROPOIDS:** This group of primates consists of monkeys, apes, and humans. Differences from the prosimians include an increased reliance on vision, a reduced reliance on smell, and a more frugivorous and general omnivorous diet. All of the anthropoid primates, with the exception of the New World Monkey, have the same dental pattern as humans.

**1. Describe the size of the skull and the size of the braincase in relation to the overall size of the skull:**

<b>Primate species:</b>	<b>Description: Size of skull</b>	<b>Description: Braincase in relation to overall size of skull</b>
New World Monkey: <i>Squirrel monkey</i>		
Old World Monkey: <i>Rhesus macaque</i>		
Common Chimp ( <i>Pan troglodytes</i> )		
Bonobo ( <i>Pan paniscus</i> )		
Gorilla		
Early Hominid: <i>Aus. afarensis</i>		
Modern Human		

**2. Are the eyes protected by a post orbital bar & plate?:**

<b>Primate species:</b>	<b>Yes</b>	<b>No</b>
New World Monkey		
Old World Monkey		
Common Chimp		
Bonobo		
Gorilla		
Early Hominid		
Modern Human		

**3. Describe the degree of facial prognathism (how far the lower jaw sticks out from the braincase):**

<b>Primate species:</b>	<b>Description:</b>
New World Monkey	
Old World Monkey	
Common Chimp	
Bonobo	
Gorilla	
Early Hominid	
Modern Human	

**4. Using the Primate Diet & Dentition worksheet, try to determine the primary dietary pattern (Folivore, Frugivore, Omnivore) of each primate based on your observations of their dentition.**

<b>Primate species:</b>	<b>Dietary Pattern:</b>
New World Monkey	
Old World Monkey	
Common Chimp	
Bonobo	
Gorilla	
Early Hominid	
Modern Human	

*Note: The prominent canines on the monkeys, chimp, bonobo, and gorilla are not due to meat eating or carnivory. Chimps and gorillas must compete against other males for dominance and access to females. The canines are much more prominent in the males for this reason.*



