Paleontology Lab: Mammalian diversity

Objectives:

- Be able to recognize a mammal.
- Be able to describe mammalian traits and evolutionary adaptations.
- Be able to identify the major orders of mammals.
- Be able to identify the characteristics of primates.

Materials needed for this lab:

Preserved specimens and skeletons of various mammals including primates
Human brain and sheep brain for comparison

Class Mammalia:

Mammals are warm-blooded vertebrates with a fully divided (four-chambered) heart that nourish their young with milk. Most mammals are furry, but some marine mammals have a thick layer of subcutaneous fat instead. Living mammals can be divided into a few egg-laying species (the **Monotremes,** including the platypus and echidna), the pouched mammals (**Marsupials,** including opossums, kangaroos, koalas, and others), and the placental mammals (**Eutheria**). If we include fossil lineages, we might more appropriately divide mammals into Protheria and Theria.

Subclass Prototheria:
These are mammals whose molar teeth have cusps in antero-posterior rows and whose petrosal bone is exposed within the eye socket. Most of these mammals are extinct.

Extinct prototherians include the Triconodonta, Docodonta, and Multituberculata.

Order Monotremata: Egg-laying mammals, including only the platypus and the echidna ("spiny anteater"), both now confined to Australia and New Guinea.

Examine any monotreme specimens that may be available.

Subclass Theria:

Therian mammals, with molar teeth whose molar cusps were originally arranged in opposing triangles with shear surfaces between them, the so-called tribosphenic tooth pattern. The petrosal bone is never exposed inside the eye socket (orbit).

Therian mammals are divided into infraclasses Pantotheria, Metatheria, and Theria.

Infraclass Pantotheria includes the extinct orders Symmetrodonta and Eupantotheria.

Infraclass Metatheria (Marsupials):

Marsupials are pouched mmmals with an an alisphenoid bulla and an inwardly inflected angle of the mandible. Familiar marsupials include the opossums and rat-opossums of the Americas, and a host of Australian species such as dasyures (including the Tasmanian devil), bandicoots, wombats, kangaroos, wallabies, and koalas.

Examine any available specimens representing opossums and other marsupials.

Infraclass Eutheria (Placental mammals):

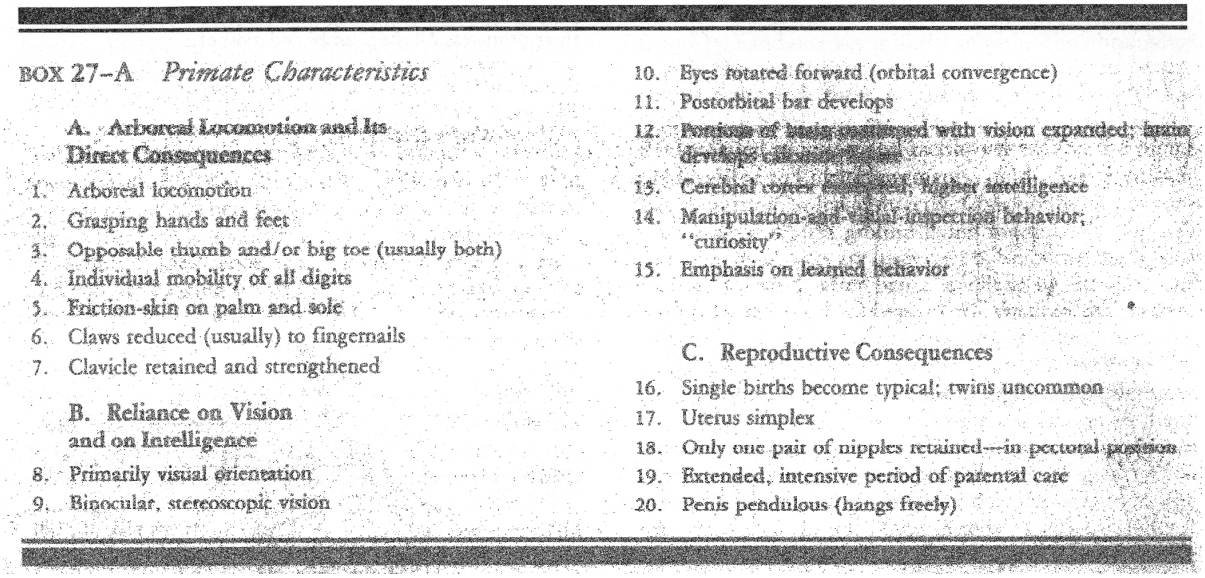
The vast majority of mammals are placental mammals in which the young develop inside the mother's uterus and are born alive. While in the uterus, the young are nourished through a **placenta,** an intimate connection of maternal and fetal blood vessels. Placental mammals include the following orders:

- **Leptictida,** an extinct group thought to be ancestral to all the rest
- **Lipotyphla (or Insectivora),** including moles, shrews, hedgehogs, etc.
- **Chrysochlorida,** the golden moles of South Africa
- **Dermoptera,** the colugo or "flying lemur"
- **Chiroptera,** the bats (the second largest mammalian order)
- **Scandentia,** the tree shrews
- **Primates,** the tarsiers, lemurs, monkeys, apes, and humans
- **Macroscelidea**, the elephant-shrews of Africa
- **Rodentia,** the gnawing mammals (squirrels, porcupines, beavers, rats, mice, and others; the largest and most diverse of all mammalian orders). Examine both their enlarged incisor teeth and their grinding cheek teeth (molars and premolars).
- **Lagomorpha,** the rabbits
- **Carnivora,** the dogs, cats, bears, racoons, weasels, hyenas, civets, etc.
- **Pinnipedia,** the seals, sea lions, and walruses
- **Pholidota,** the pangolins
- **Tubulidentata,** the aardvarks
- **Cetacea,** the whales (including porpoises and dolphins)
- **Artiodactyla,** the even-toed hoofed mammals (pigs, hippos, camels, giraffes, deer, goats, sheep, cattle, antelopes, gazelles, etc.)
- **Perissodactyla,** the odd-toed hoofed mammals (rhinoceroses, tapirs, horses)
- **Hyracoidea,** the hyraxes
- **Proboscidea,** the elephants, mammoths, and mastodonts
- **Sirenia,** the manatees and dugongs
- **about two dozen additional orders that are extinct**

Examine representatives of as many of these mammalian orders as you can. (Please also examine additional skulls on the third floor lobby, near the elevators.)
Which are the two largest (most species-rich) orders?
Are you familiar with any mammals not represented in lab? Where have you seen them?
Which orders are not represented in lab?

Order Primates

The order to which we belong also includes lemurs, tarsiers, monkeys, and apes. Important characteristics of the primates include the following:



BOX 27–A *Primate Characteristics*

A. Arboreal Locomotion and Its Direct Consequences

1. Arboreal locomotion
2. Grasping hands and feet
3. Opposable thumb and/or big toe (usually both)
4. Individual mobility of all digits
5. Friction-skin on palm and sole
6. Claws reduced (usually) to fingernails
7. Clavicle retained and strengthened

B. Reliance on Vision and on Intelligence

8. Primarily visual orientation
9. Binocular, stereoscopic vision
10. Eyes rotated forward (orbital convergence)
11. Postorbital bar develops
12. Portions of brain concerned with vision expanded; brain develops [illegible]
13. Cerebral cortex [illegible]; higher intelligence
14. Manipulation-and-visual-inspection behavior; "curiosity"
15. Emphasis on learned behavior

C. Reproductive Consequences

16. Single births become typical; twins uncommon
17. Uterus simplex
18. Only one pair of nipples retained—in pectoral position
19. Extended, intensive period of parental care
20. Penis pendulous (hangs freely)

Examine several primates, and compare the above features in primates and nonprimates. Pay special attention to the following:

A. Arboreal adaptations

1. Examine the **hands and feet** of as many primates and non-primates as you can.
   How many digits are present in each species? Are any digits missing or reduced in size? Are the thumbs and big toes **opposable**? How can you tell? (Human feet are unusual in <u>not</u> having an opposable big toe, which other primates have.)
2. Can you tell if the digits are individually mobile?
3. Do the digits end in claws, hoofs, or fingernails? Are there any exceptions?
4. Examine the palmar (palm) and plantar (sole) surfaces for friction skin. (Don't forget to examine your own hands and feet.)
5. Examine the shoulder region and locate the **clavicle.** Is it present? Is it strong or weak? How does the position of the shoulder relate to the presence of a clavicle?

B. Sensory adaptations and intelligence

1. Examine all skulls for evidence of **vision** and also of **olfaction** (smell).
(Please also examine additional skulls on the third floor lobby, near the elevators.)
   How long is the snout? How large is the portion of the skull devoted to olfaction?
   How large are the eyes? Is there evidence of **orbital convergence?**
   Is a **postorbital bar** present? Is the eye socket walled off from the jaw muscles?

How does orbital convergence relate to stereoscoptic vision? To manipulatory behavior? Of the species you have examined, which has the greatest orbital convergence? Which has the least? Can you explain these differences?

2. How large a portion of each skull is devoted to the brain?
3. If brains or brain models are available, compare as many primates and nonprimates as you can:
   How large are the **cerebral hemispheres**? How large is the **cerebral cortex** (outer layer)? How strongly **convoluted** (folded) is the brain surface?