

# Extant Primates

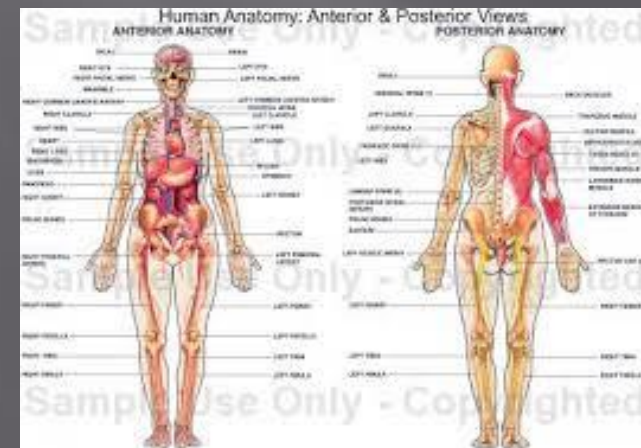
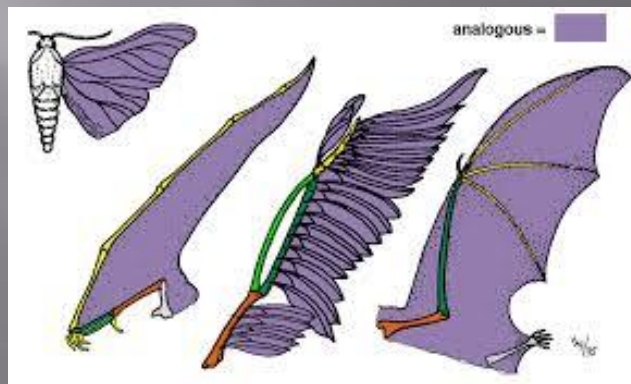
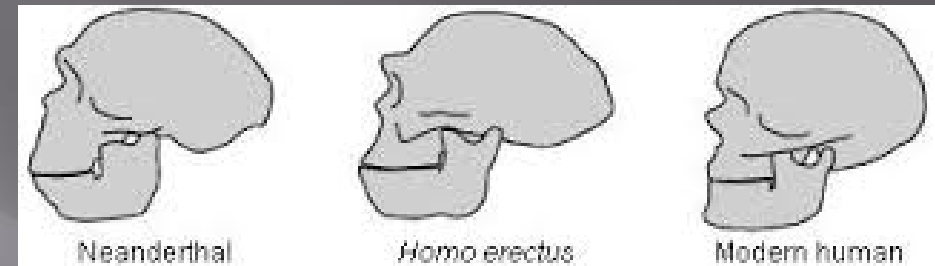


# Important Terms

▣ **Morphology:** the study of the form or shape of an organism.

Different branches-

- Comparative Morphology
- Functional Morphology
- Anatomy



# A Survey of the Living Primates

- ▣ There are approximately 230-270 species of nonhuman primates
- ▣ Primates belong to:
  - Vertebrate class - Mammalia
  - Subgroup of placental mammals
- ▣ Each lineage or species possess unique qualities that make it better suited to a particular habitat and lifestyle.

# Primates and other mammals

- ▣ Endothermy
- ▣ Growth
- ▣ Mammary glands
- ▣ Viviparity
- ▣ Increased parental care
- ▣ Heterodont dentition
  - Dental formula
  - Occlusion of teeth
  - Replaced only once

# Primate Features

- ▣ Ancestral mammalian traits:
  - Generalized body plan
  - Retention of some bones
  - Pentadactyly
  - Generalized heterodont dentition



# Primate Features

Shared derived traits of primates

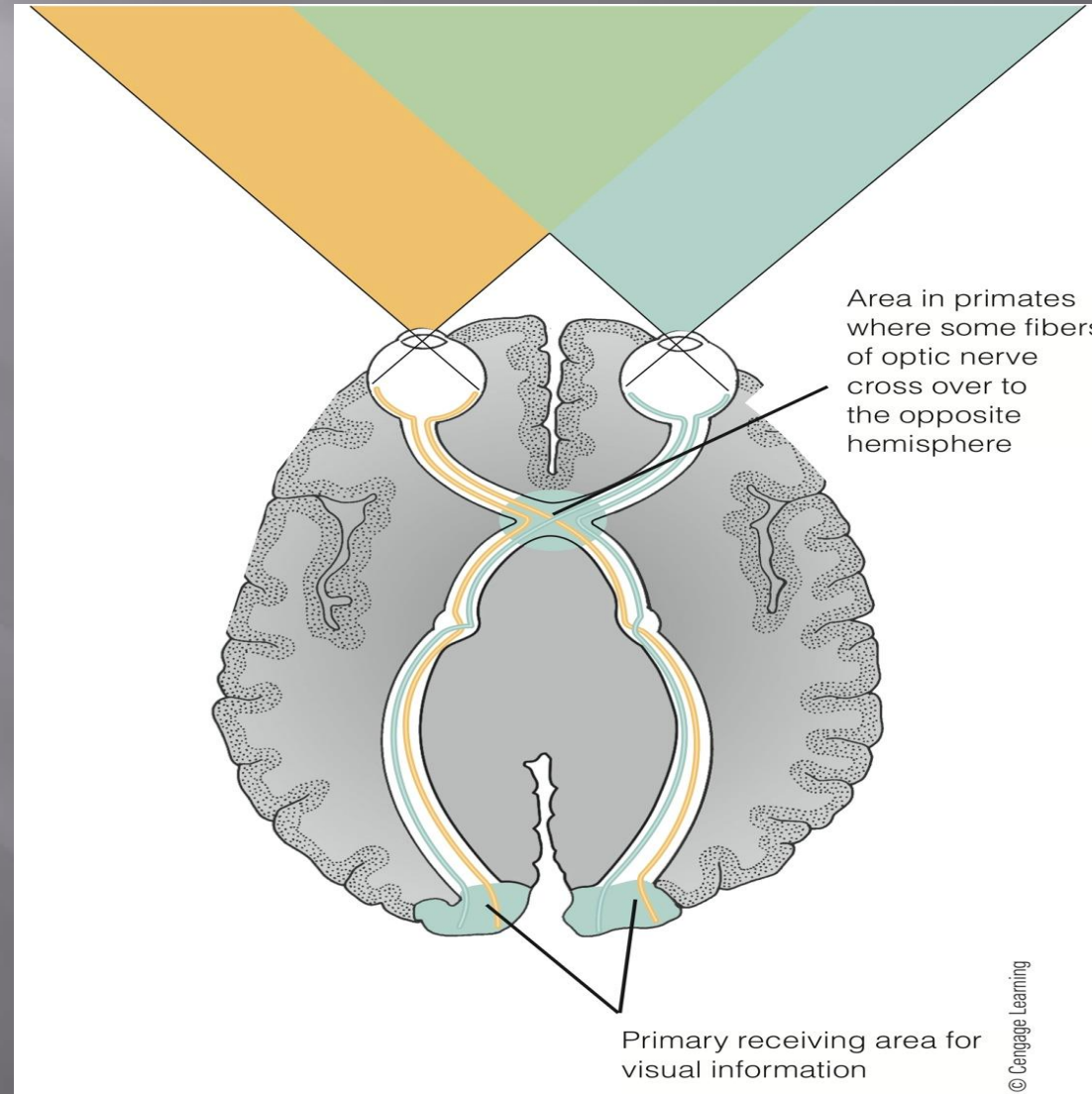
- ▣ Grasping hands and feet
- ▣ Nails instead of claws
- ▣ Forward facing eyes
- ▣ Shorter snout
- ▣ Post-orbital bar/closure
- ▣ Large brains



# The Senses and the Brain: Sight

- ▣ Color vision, but reduced in males of some New World species;
- ▣ Forward facing eye sockets that enable **binocular** vision;
- ▣ Depth perception, called **stereoscopic** vision;
- ▣ Visual information is transmitted to both hemispheres;
- ▣ Visual information is organized into three-dimensional images.

# Binocular Vision in Primates





# Primate Adaptation

- ▣ Primate anatomical traits evolved as adaptations to environmental circumstances.
  - Arboreal Hypothesis
  - Visual Predation Hypothesis
  - Angiosperm Radiation Hypothesis

# Arboreal Hypothesis

- ▣ Arboreal living was the most important factor in the evolution of primates.
- ▣ Prehensile hand is adapted to climbing in the trees.
- ▣ A variety of foods led to the omnivorous diet and generalized dentition.

# Visual Predation Hypothesis

- ▣ Primates may have first adapted to shrubby forest undergrowth and the lowest tiers of the forest canopy.
- ▣ Forward facing eyes enabled primates to judge distance when grabbing for insects.
- ▣ Flowering plants may have influenced primate evolution.

# Angiosperm radiation hypothesis

- ▣ This hypothesis proposes that primates developed in conjunction with the rise of the flowering plants
  - Color vision adaptation

# Primate Adaptations

# Geographical Distribution of Living Nonhuman Primates



# Habitat Types Primary Forest



# Habitat Types Secondary Forest





# Habitat Type Gallery Forest



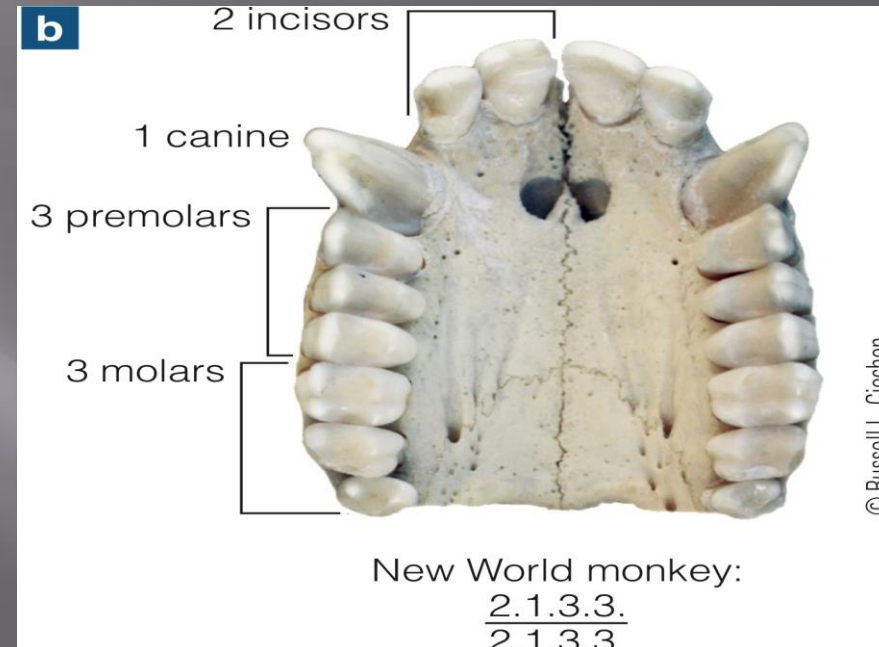
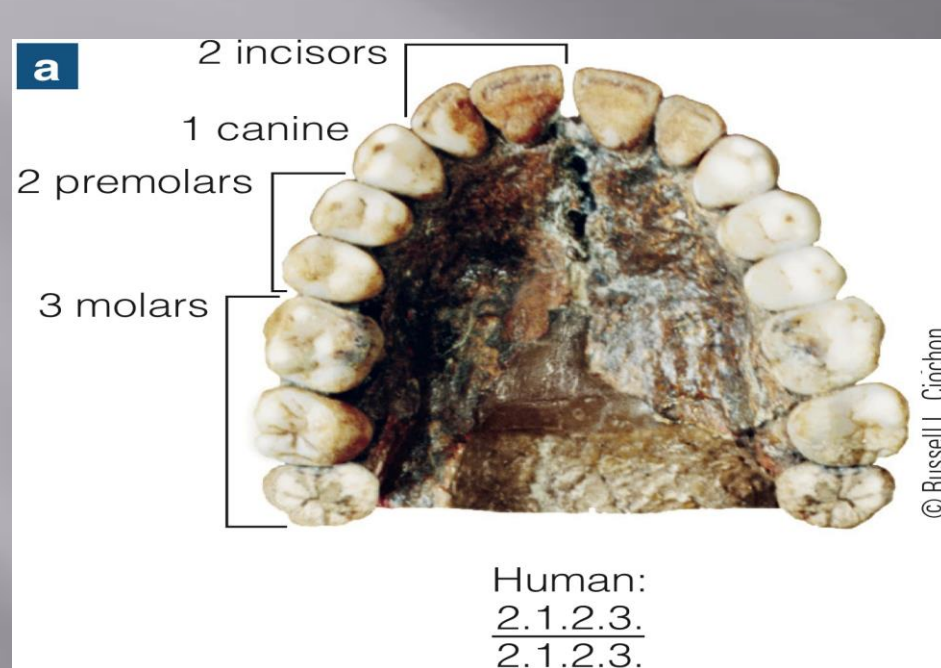
# Habitat Type Woodland



# Habitat Types Savannah



# Dental Formula



- A dental formula indicates the number of each tooth type in each quadrant of the mouth
- The human maxilla (a) illustrates a dental formula characteristic of Old World monkeys, apes, and humans. The *Cebus* maxilla (b) shows the dental formula typical of most New World monkeys.

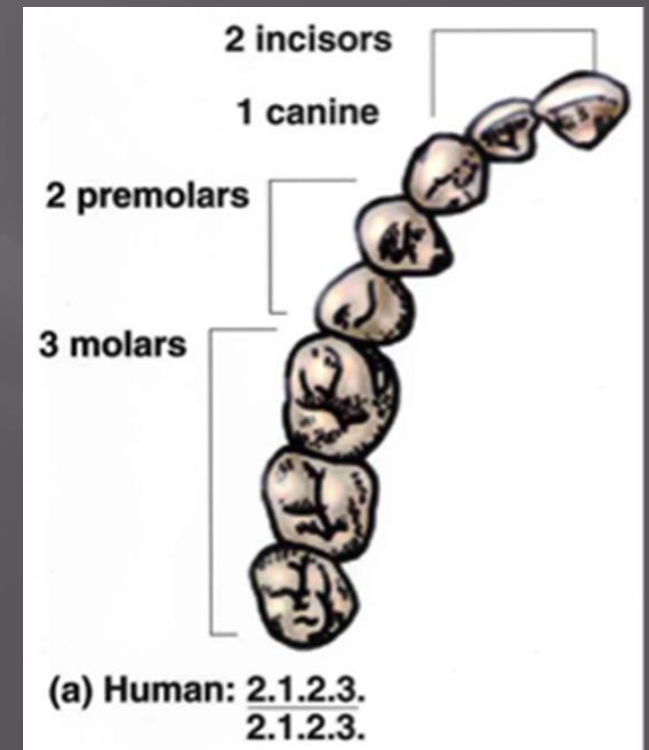
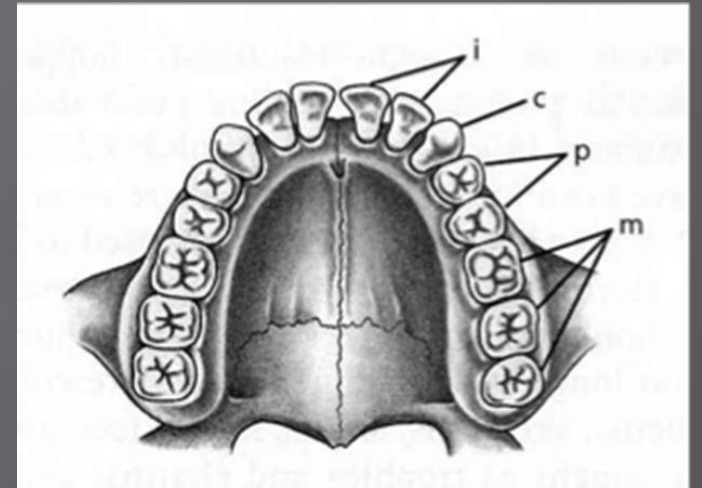
# Primate Morphology

## □ DENTITION

### Heterodonts (Primates)

- Have different kinds of teeth
- Incisors
- Canines
- Premolars
- Molars
- Dental formula

e.g. Humans have dental formula of  $\frac{2.1.2.3}{2.1.2.3}$ .



# Primate Diets and Associated Morphology

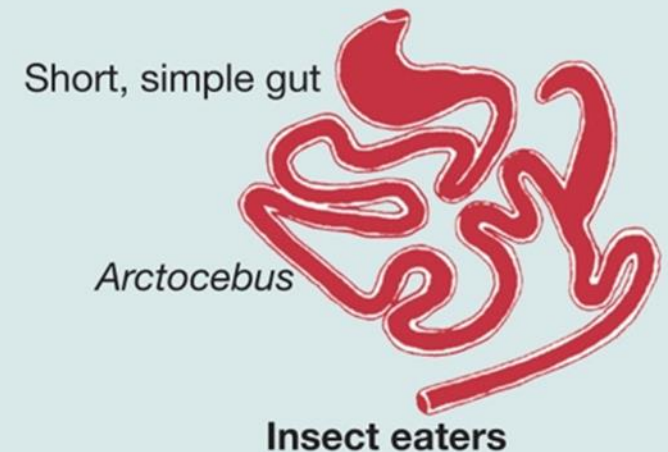
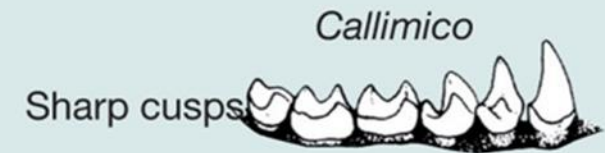
- ▣ Insectivores
- ▣ Frugivores
- ▣ Folivores
- ▣ Gumnivores
- ▣ Omnivore



# Primate Diets and Associated Morphology

## INSECTIVORES

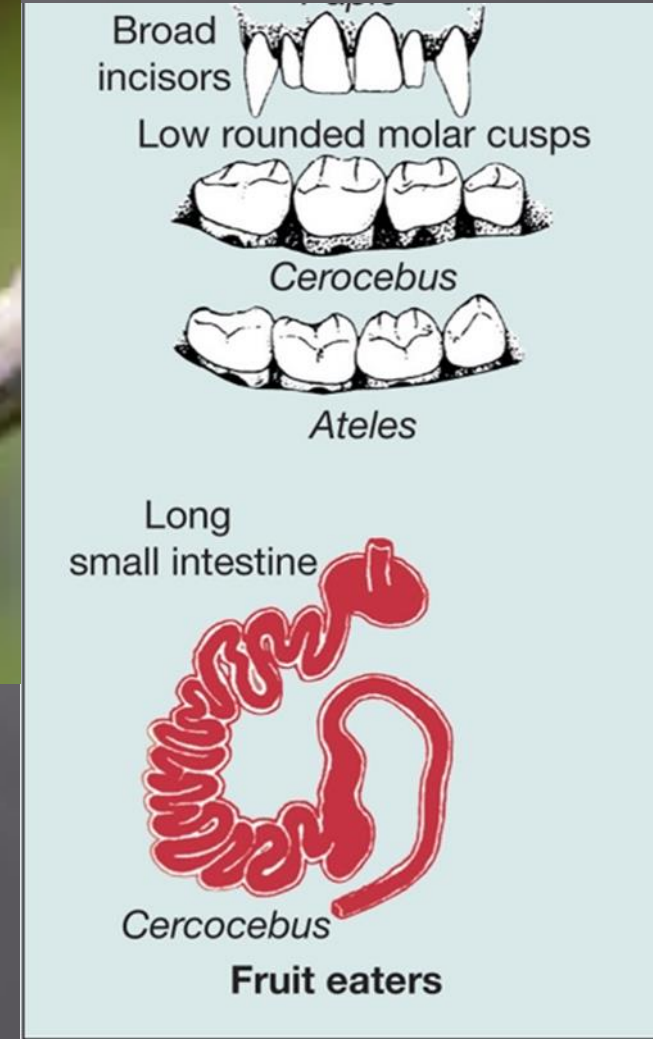
- Eat insects
- Small body size
- Sharp tooth cusps
- Tall tooth cusps
- Simple digestive system



# Primate Diets and Associated Morphology

## FRUGIVORES

- Eat fruit
- Medium body size
- Broad incisors
- Low cusped, relatively flat molars
- Fairly large digestive system, but not as specialized as those of folivores

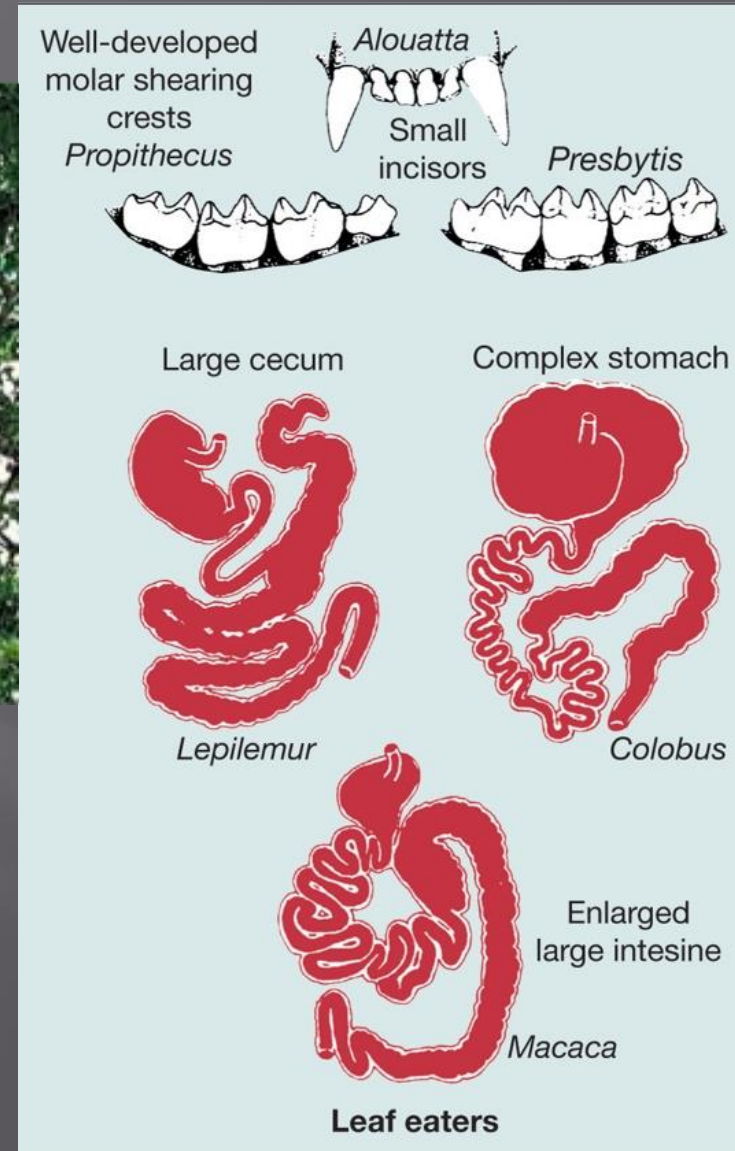




# Primate Diets and Associated Morphology

## FOLIVORES

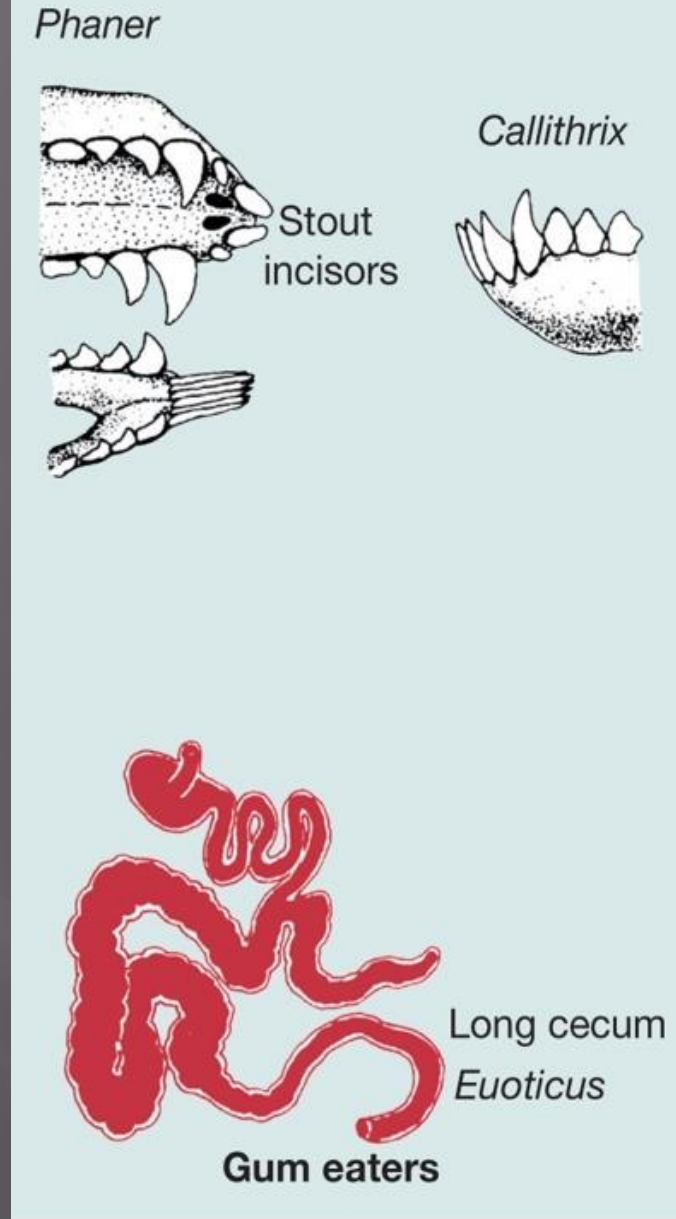
- Eat leaves
- Large body size
- Small incisors
- Sharp shearing crests on teeth
- Enlarged, well-developed digestive system



# Primate Diets and Associated Morphology

## GUMNIVORES

- Relatively small body size
- Big, robust incisors
- Some Callitrichids (marmosets) have
  - **Tegulae** (claw like nails)



# Primate Locomotion and Associated Morphology

Terrestrial Quadrupedalism



Arboreal Quadrupedalism



Suspensory (Brachiation)



Vertical Clinging and Leaping

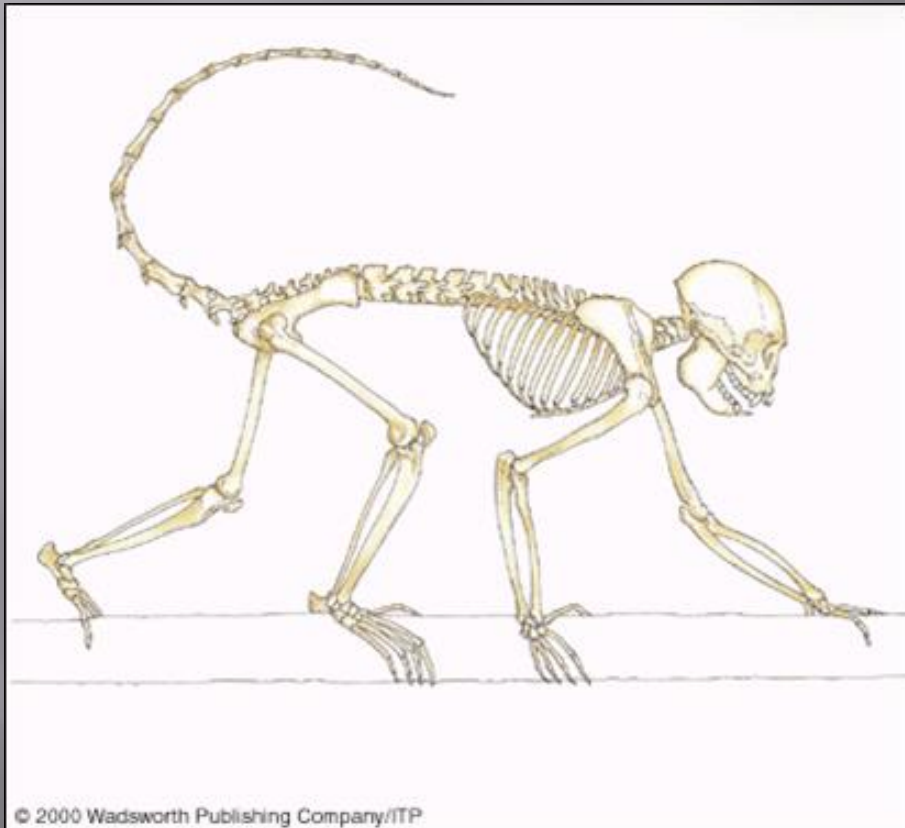


Bipedalism



# Locomotor Morphology

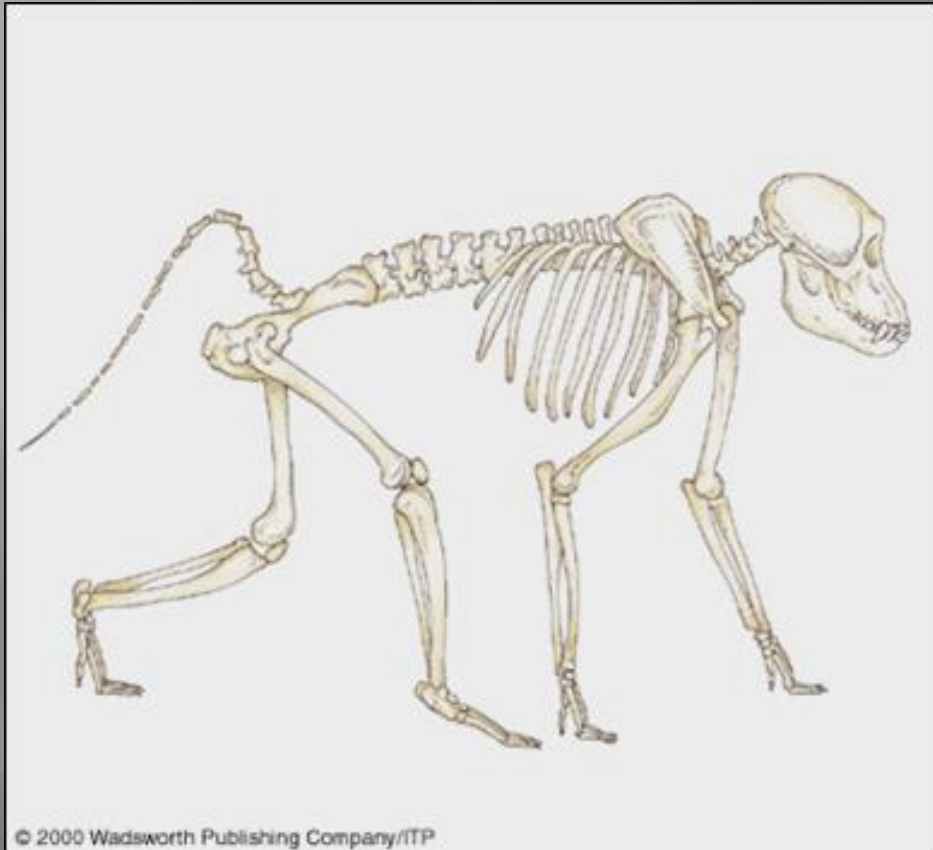
## Arboreal quadrupeds



- balance and move on tree branches, which are unstable, uneven, discontinuous, and fairly small
- Mobile joints because often flexed (bent) and abducted (opened away from the body)
- Forelimbs and hind limbs of similar length
- Forward and backwards motion
- Longer tails

# Locomotor Morphology

## Terrestrial quadrupeds



- less focused on balance since on ground
- Forelimbs and hind limbs of similar length
- Less mobile joints  
\*Still use trees so joints not as restricted as cursors (e.g., horses, cheetahs)
- Shorter tails
- Forward and backwards motion

# Knucklewalking

All the apes, to varying degrees, have arms that are longer than legs, and some (gorillas, bonobos, and chimpanzees) practice a special form of quadrupedalism called knucklewalking.



# Locomotor Morphology

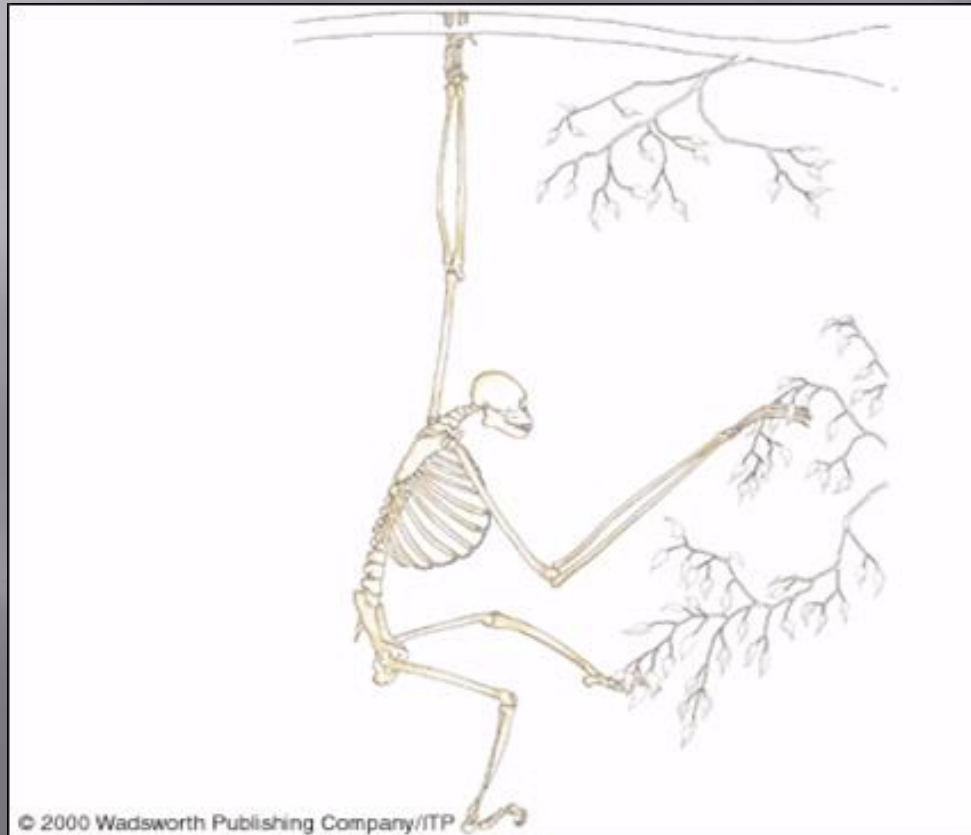
## Leapers



- flex and extend their legs considerably
- Restrict mobility to increase efficiency and decrease injury
- Longer hind limbs and elongated ankle bones

# Locomotor Morphology

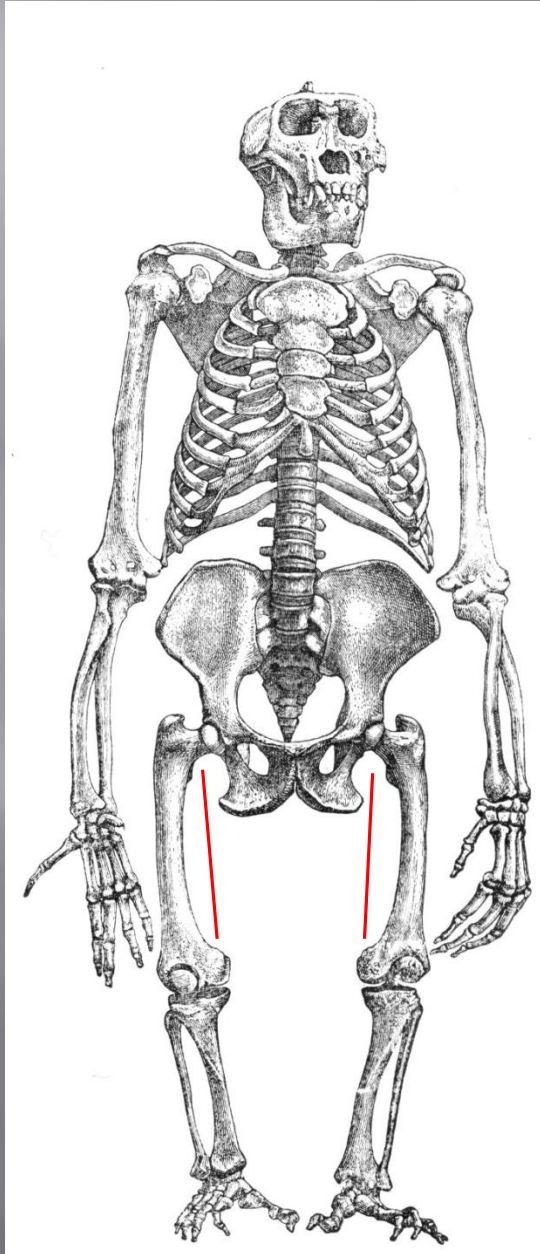
## Suspensory primates



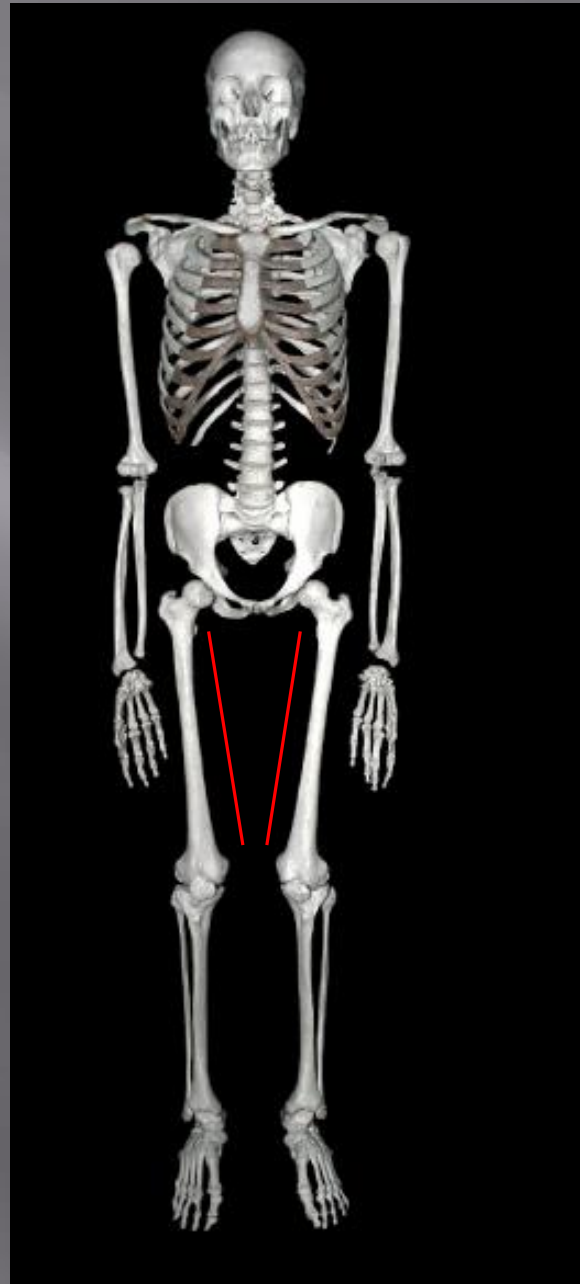
- have a lot of mobility in their joints for hanging and climbing
- Longer forelimbs than hind limbs



Gorilla

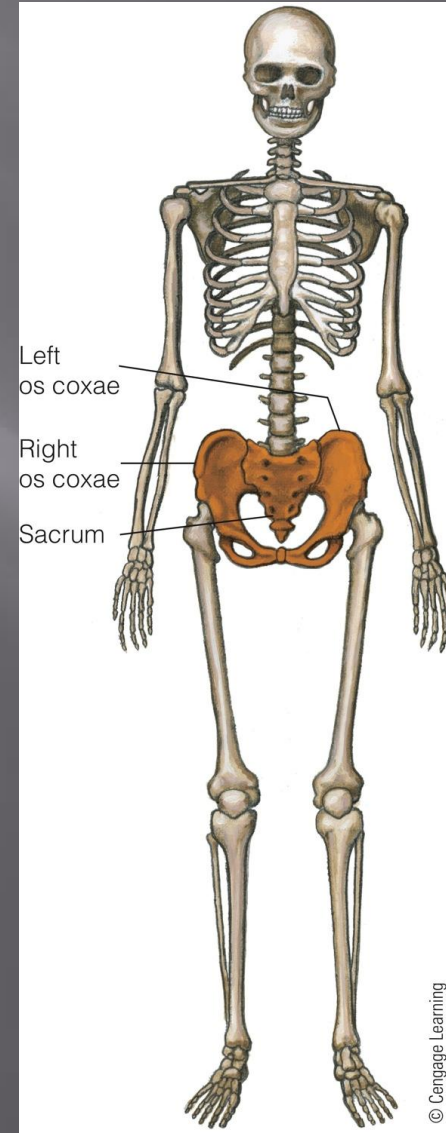


Human

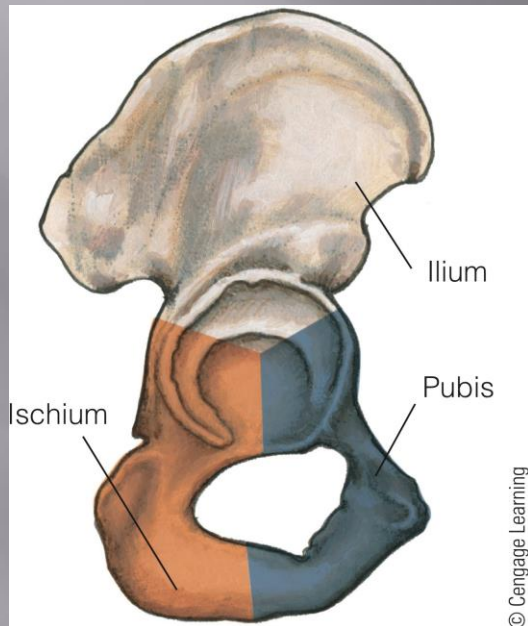


# The Bipedal Adaptation

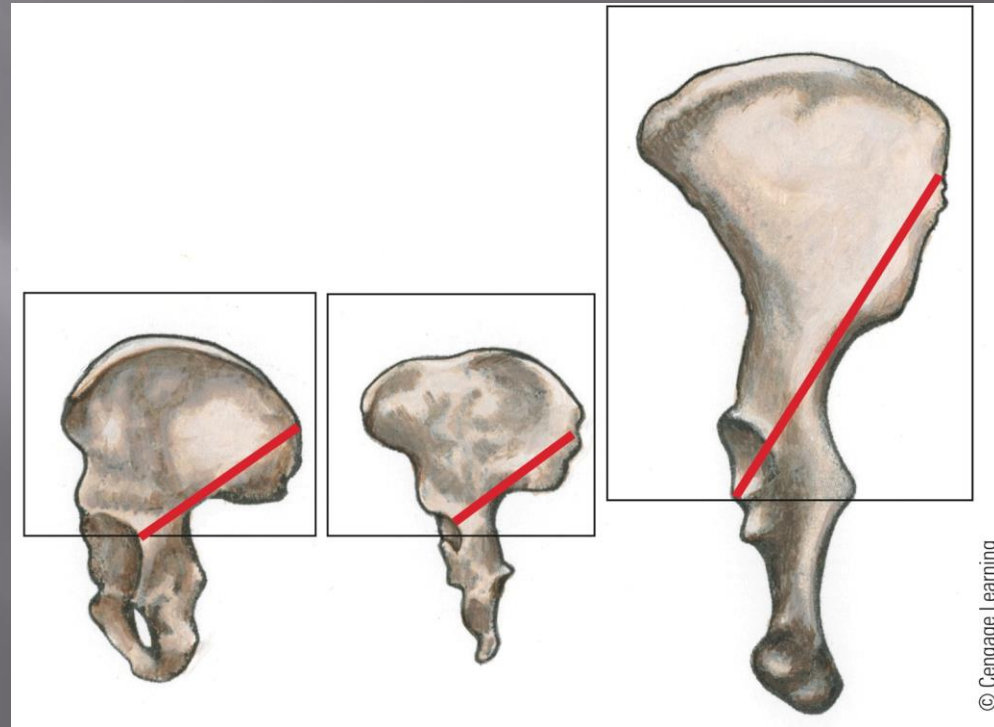
- ▣ The earliest hominins are all from Africa date from 6+ mya
- ▣ Most became extinct. Why? Were some our direct ancestors?
- ▣ The bipedal adaptation suggests most dramatic changes occur in the pelvis.



# Human Ossa Coxae



(LEFT) The human os coxae, composed of three bones.



(RIGHT) Ossa coxae. (a) *Homo sapiens*. (b) *Early hominin (australopith)* from South Africa. (c) *Great ape*. Note especially the length and breadth of the iliac blade (boxed) and the line of weight transmission (shown in red).

# Structure of Bipedalism

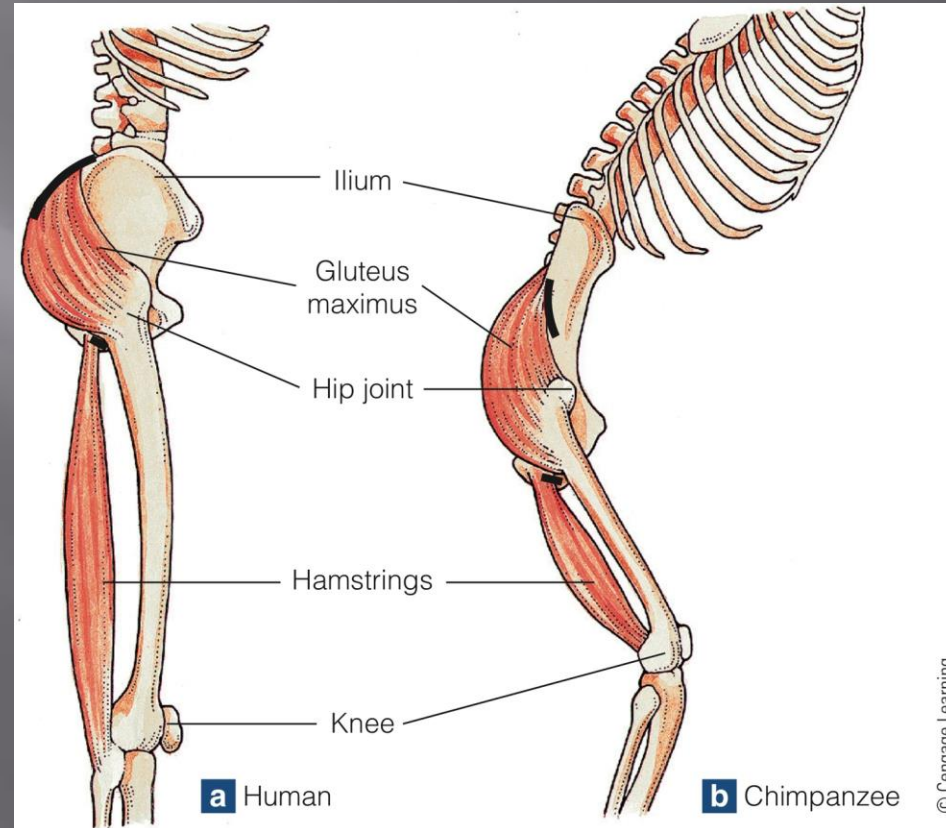
- ▣ Shorter and broader pelvis stabilizes weight transmission from lower back to hip joint
- ▣ Bipedalism altered the relationship of gluteus maximus muscle

# Bipedalism and Gluteus

Comparisons of important muscles that act to extend the hip.

The attachment surface (origin, shown in red) of the gluteus maximus in humans is farther in back of the hip joint than in a chimpanzee standing bipedally.

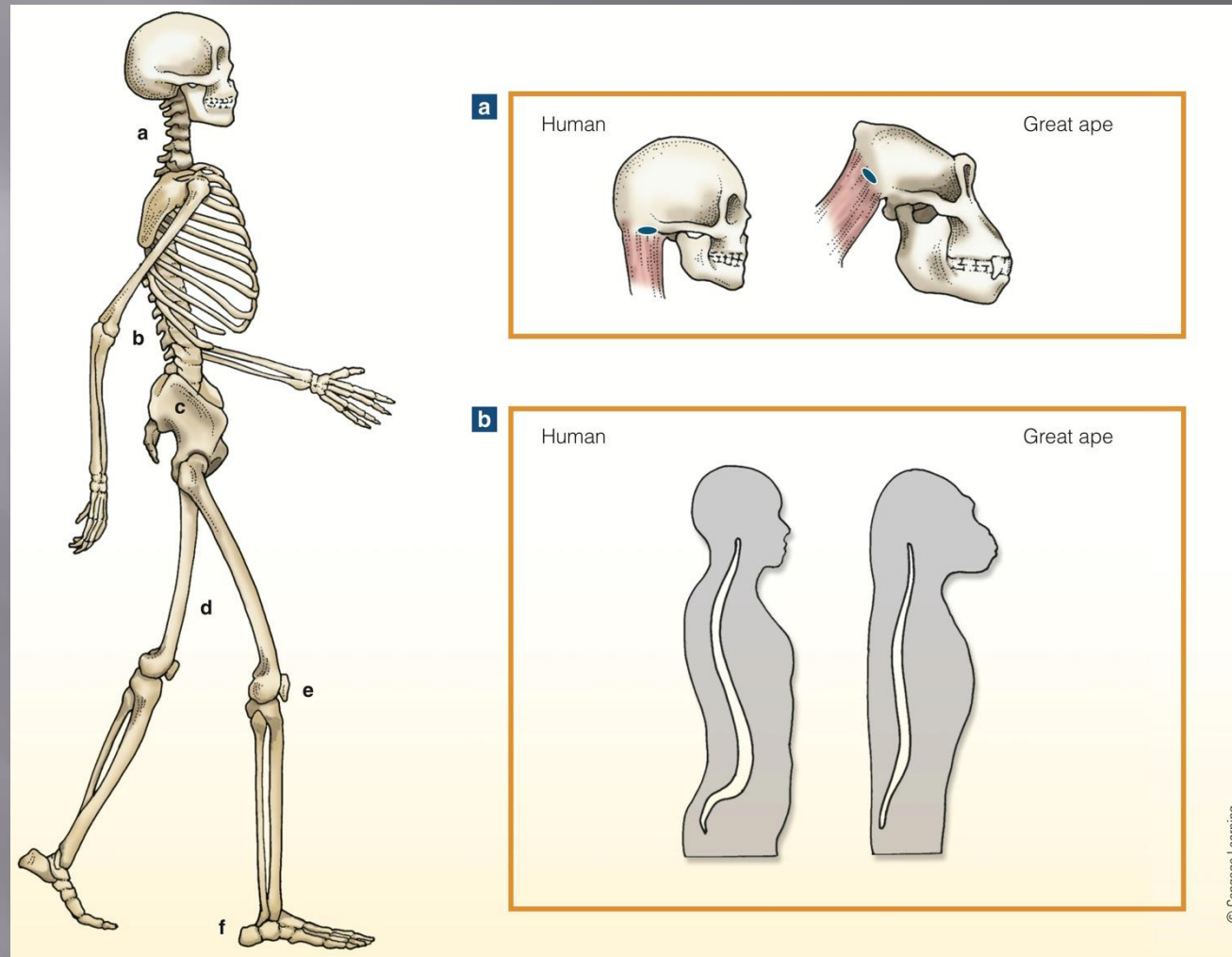
Chimpanzees' hamstrings are farther in back of the knee.



# Habitual and Obligate

Hominin bipedalism is both habitual and obligate

- **habitual**, in that bipedalism is standard and most efficient form of locomotion;
- **obligate**, in that hominines cannot locomote efficiently in any other way.

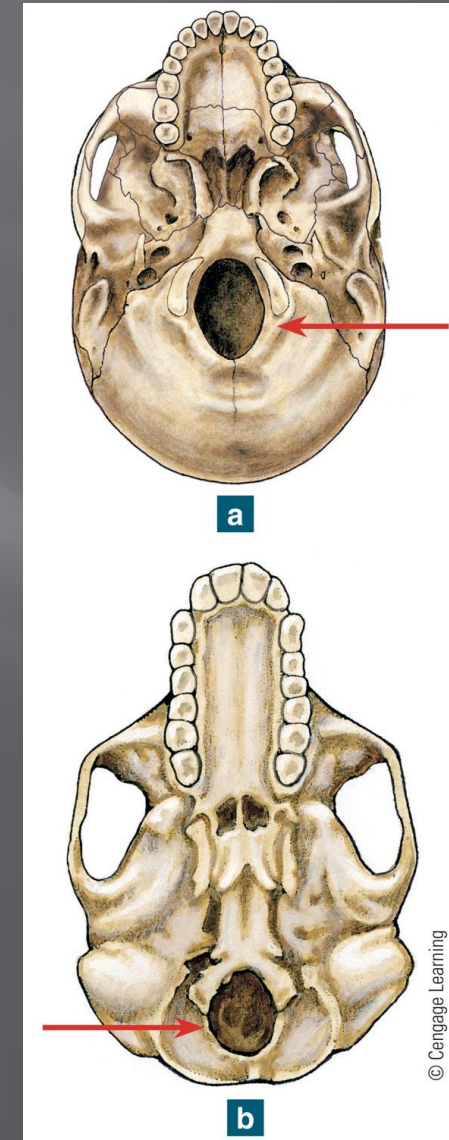


© Cengage Learning

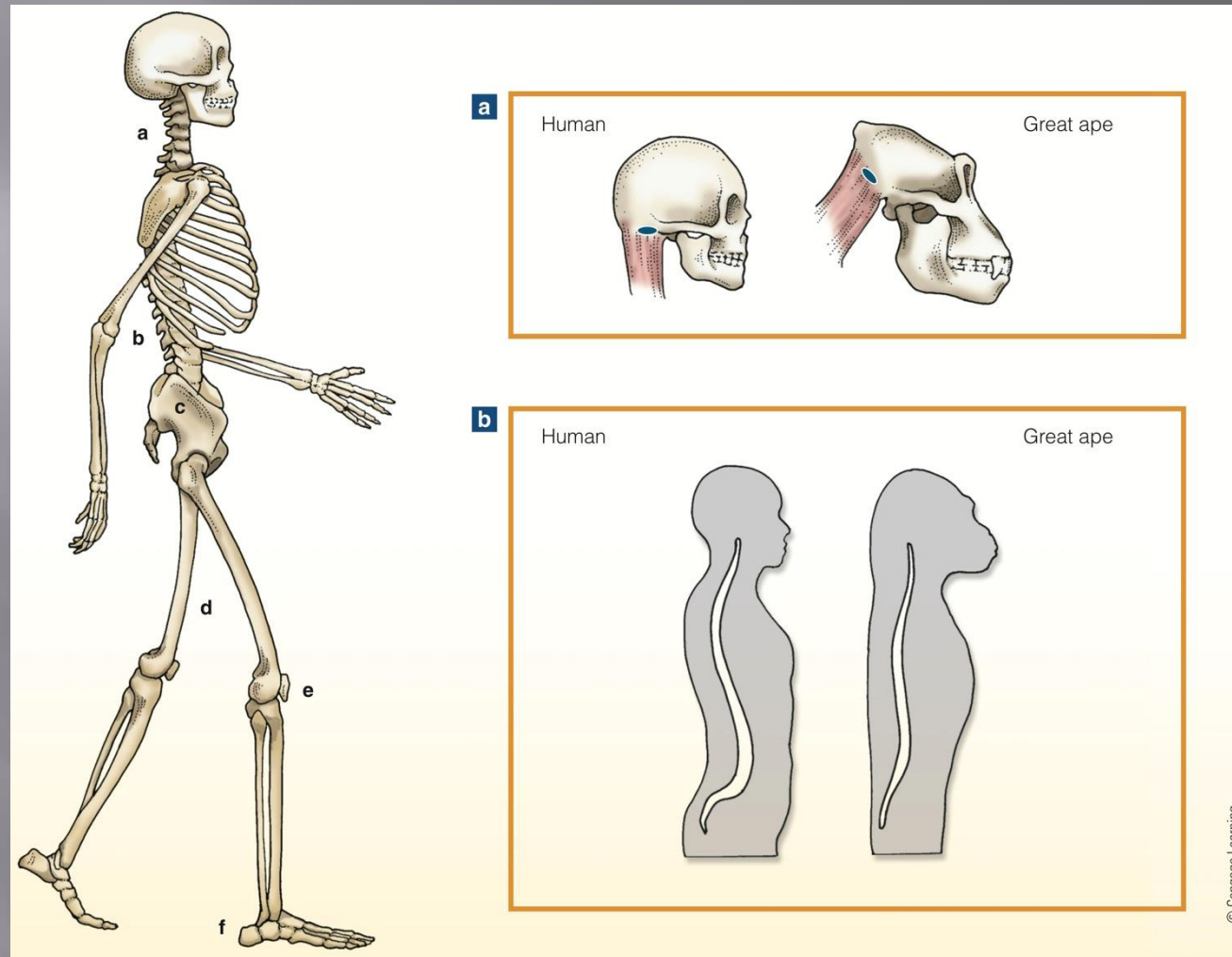
The foramen magnum (a) shown in red, is repositioned farther underneath the skull, so (b) the head is more or less balanced on the spine (and thus requires less robust neck muscles to hold the head upright).

# Position of the Foramen Magnum

- (a) a human and
- (b) a chimpanzee. The more forward position in the fully bipedal human cranium.

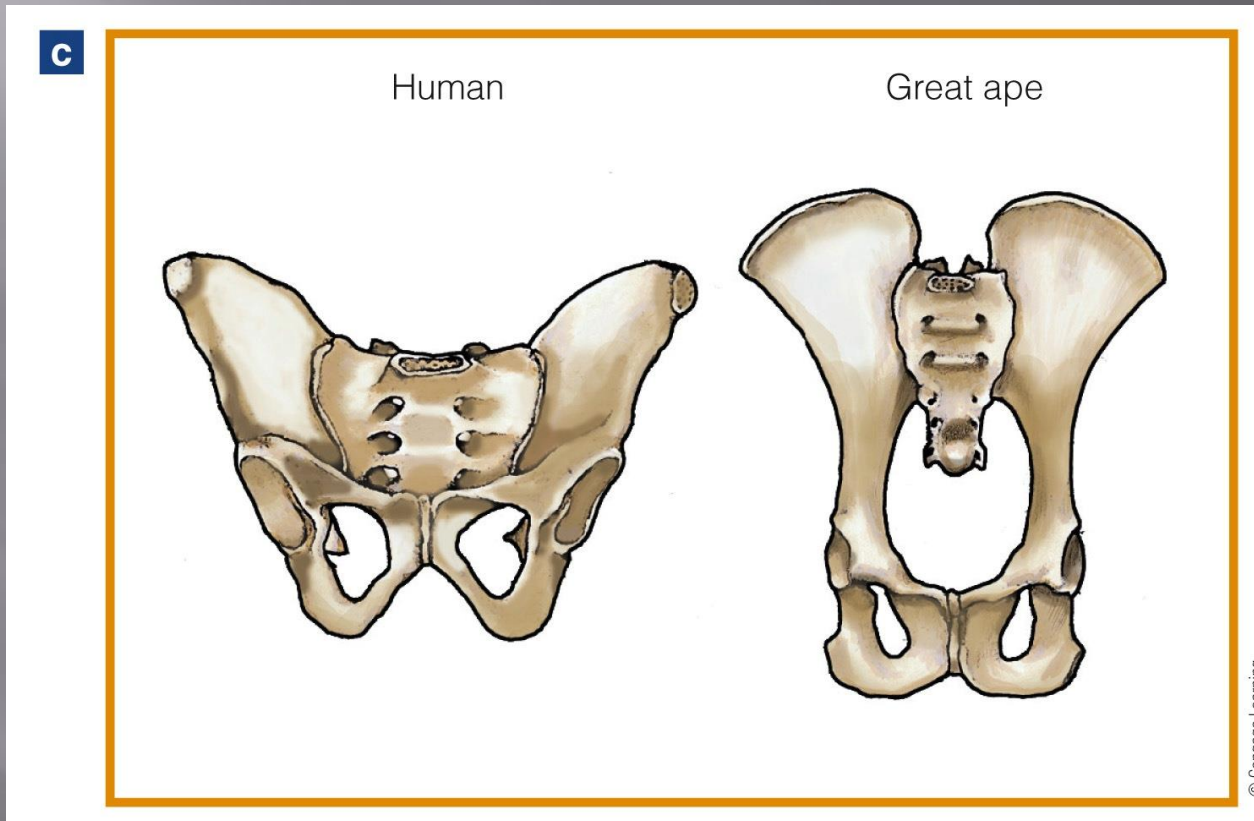






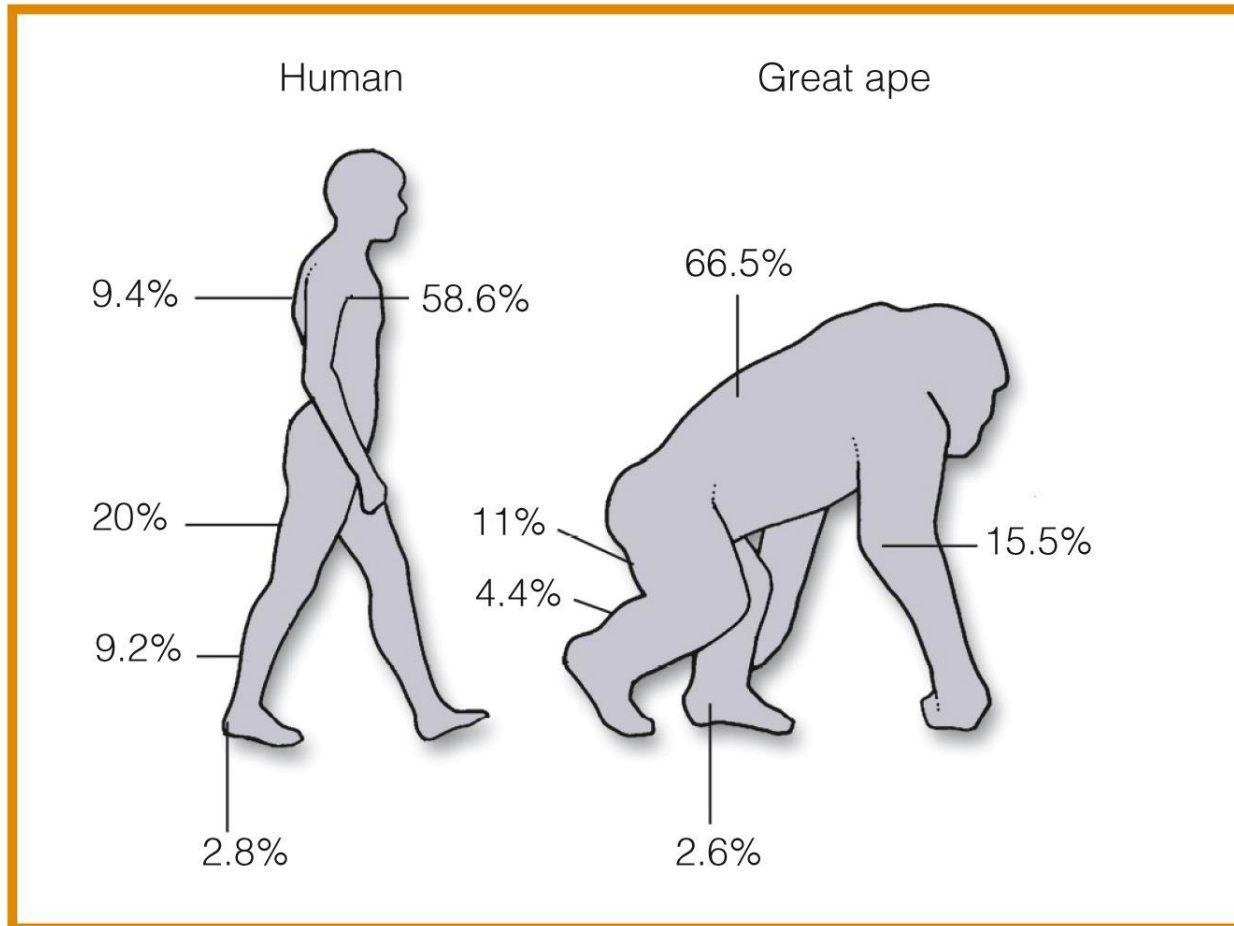
The spine has two distinctive curves — (b) a backward (thoracic) one and a forward (lumbar) one — that keep the trunk (and weight) centered above the pelvis.

# Pelvis



Basin-shaped pelvis supports internal organs; the ossa coxae are shorter and broader, stabilizing weight transmission.

d

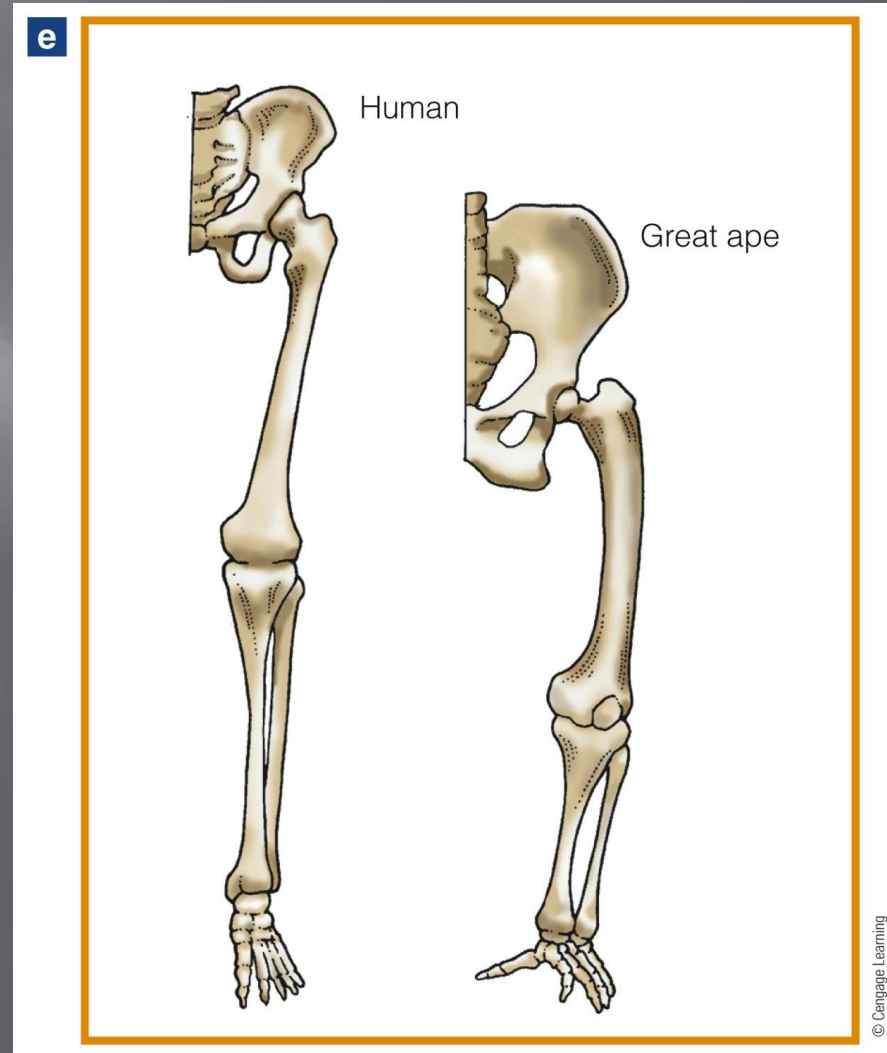


© Cengage Learning

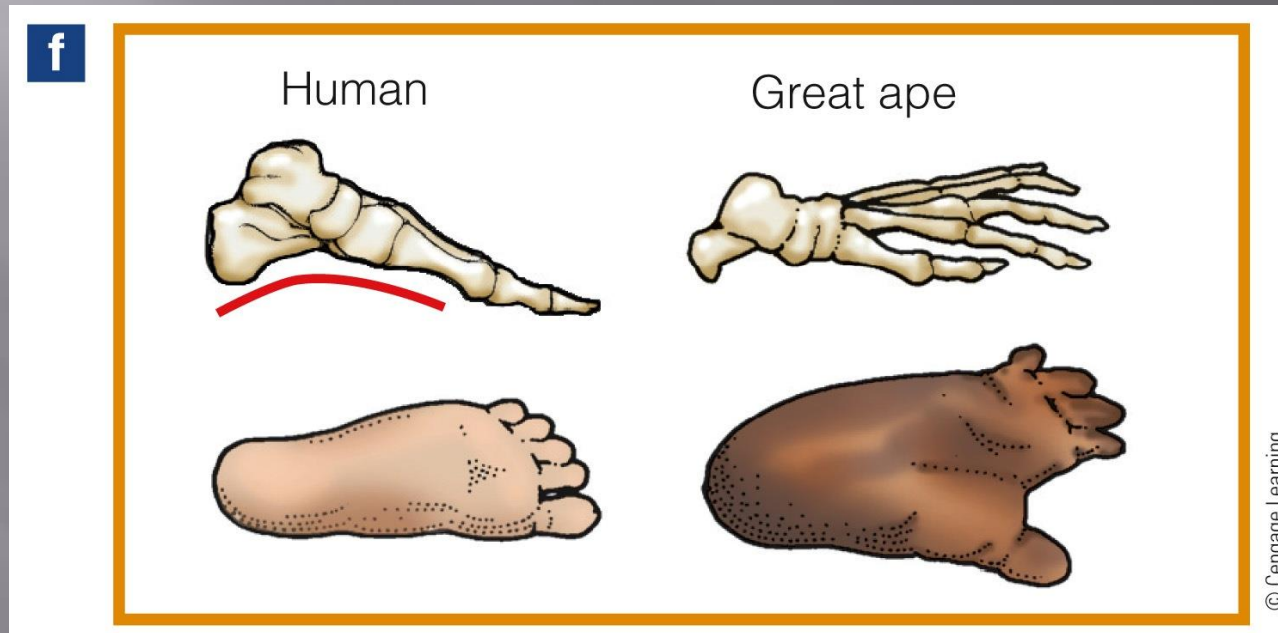
Elongated lower limbs. Note proportional lengths of various body segments (e.g., in humans the thigh comprises 20% of body height, while in gorillas it comprises only 11%).

# Femurs

The femur is angled inward, keeping the legs more directly under the body; modified knee anatomy permits full extension of this joint.



# Feet



Enlarged big toe brought in line with the other toes; distinctive longitudinal arch helps absorb shock and adds propulsive spring.

# Feet

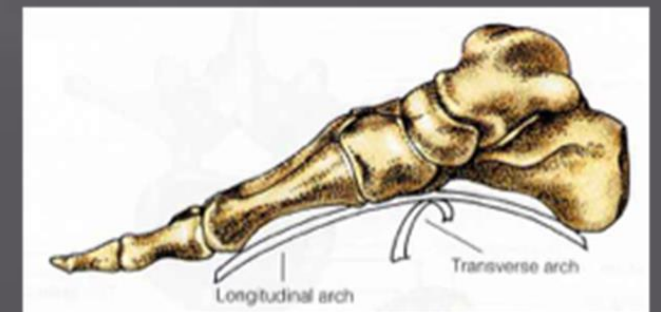
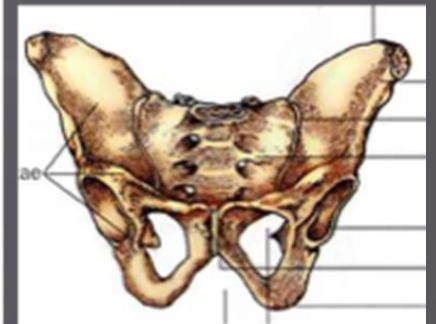
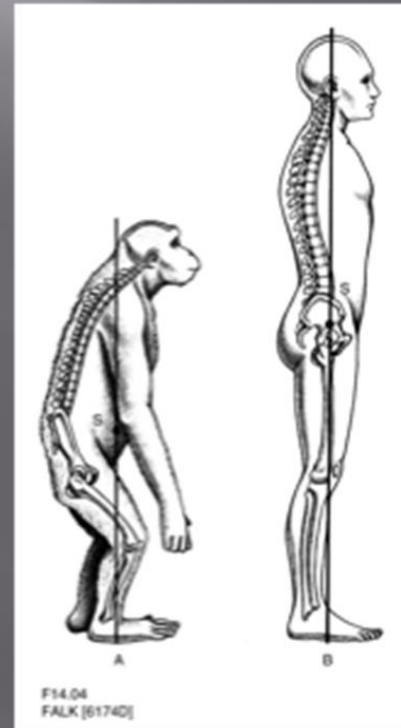
A nearly complete hominin foot (OH 8) from Olduvai Gorge, Tanzania, suggesting a well-adapted bipedal gait.

- well developed arches
- considerable flexibility in the ankle suggesting climbing



# Locomotor Bipeds Morphology

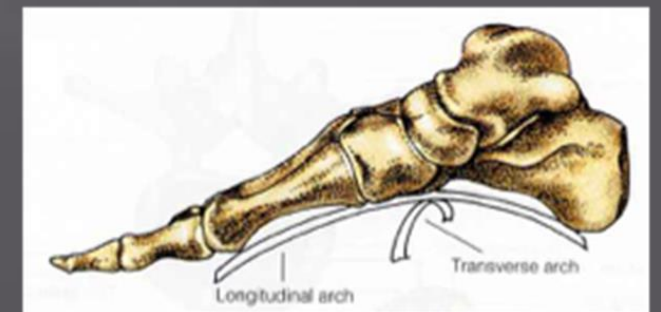
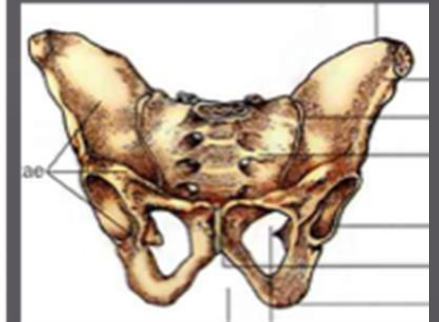
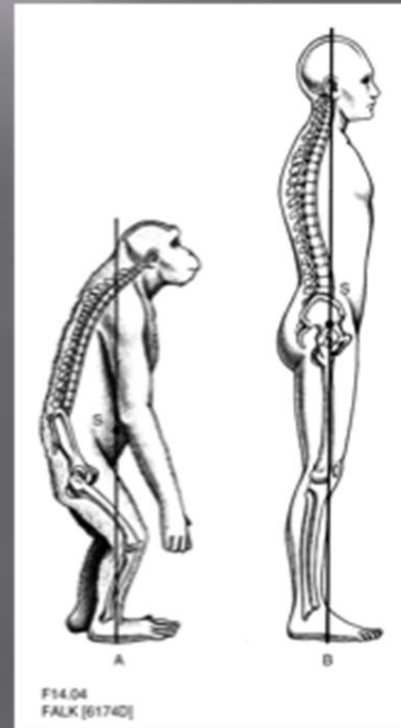
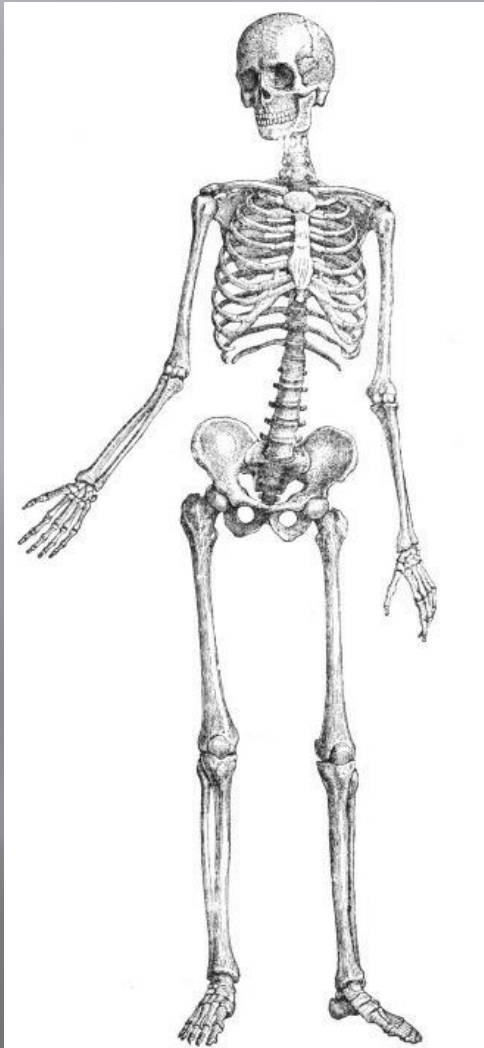
- Have adducted big toe
- Shorter pelvis
- Curved spine
- Arched feet
- Valgus knee



# Locomotor Morphology

## Bipeds

- Have adducted big toe
- Shorter pelvis
- Curved spine
- Arched feet
- Valgus knee

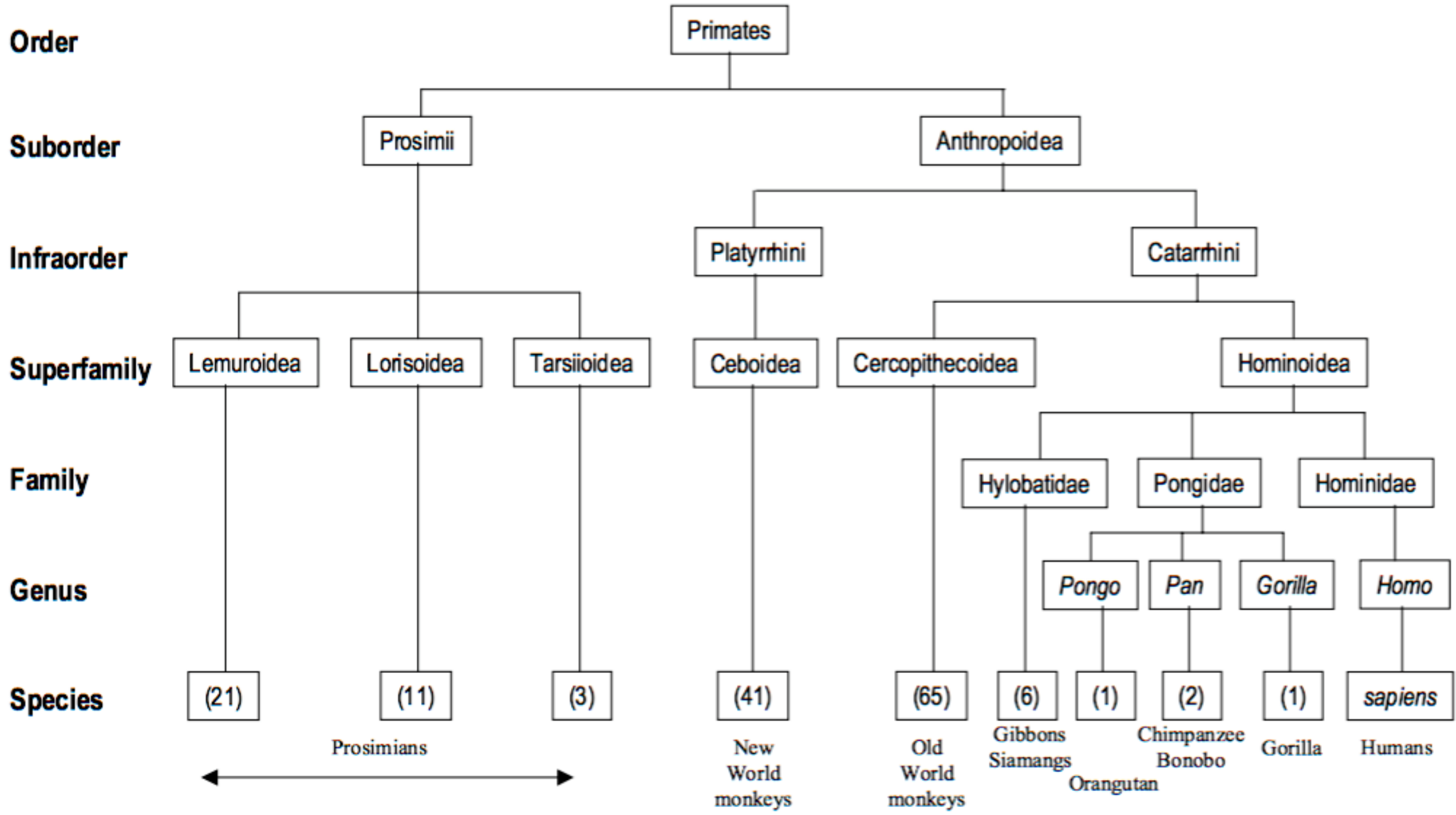




# Primate Classification

# Primate Classification

- ▣ Traditional (Phenetic) Classification
- ▣ Evolutionary (Cladistic) Classification



# Traditional Phenetic Classification

## PROSIMIANS

- ▣ Smaller
- ▣ Greater reliance on olfaction
- ▣ Eyes more to the side of the face
- ▣ Mostly nocturnal
- ▣ Shorter gestation and maturation periods
- ▣ Dental comb or grooming claws
- ▣ Less social/more solitary
- ▣ Scent marking – mark territories

## ANTHROPOIDS

- ▣ Larger
- ▣ Reduced reliance on olfaction
- ▣ Eyes more to the front of the face
- ▣ Mostly diurnal
- ▣ Longer gestation and maturation periods
- ▣ No dental combs / nails
- ▣ More social

# Evolutionary (Cladistic) Classification

- ▣ The suborder primates are divided into two smaller categories
  - Strepsirhini- lemurs & lorises
  - Haplorhini- tarsier, monkeys, apes, and humans.
- ▣ Geneticists can make direct comparisons between the entire genetic make up of different species.

# Primates

## Strepsirrhines

## Haplorhines

Lemuriformes  
(Lemurs)

Lorisiformes  
(Lorises and Galagos)

Tarsiformes  
(Tarsiers)

Anthropoids

Platyrrhines  
(New World Monkeys)

Catarrhines  
(Old World  
Monkeys and  
Apes)

Hominoids (Apes)

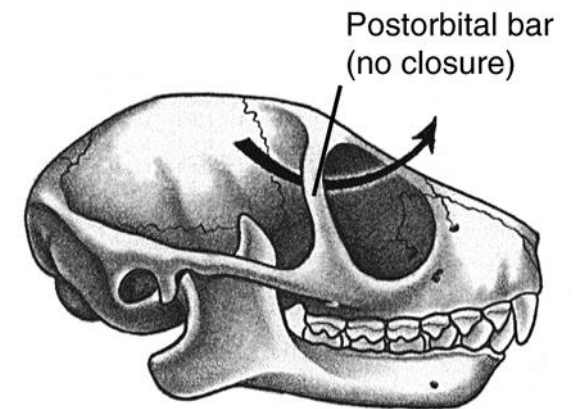
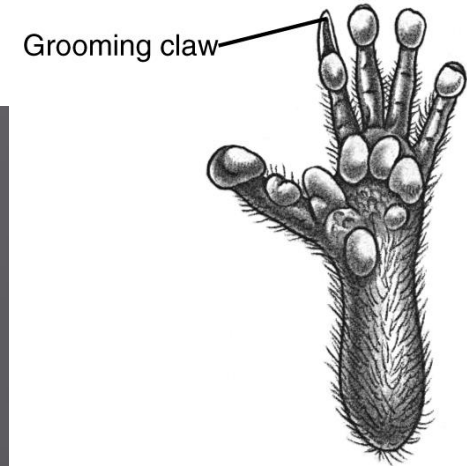
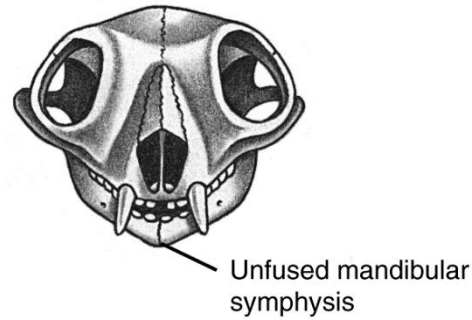
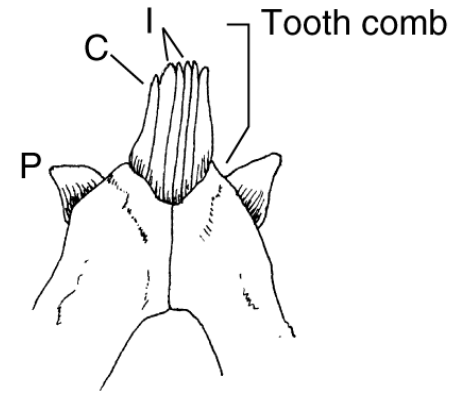
Cercopithecoids  
(Old World Monkeys)

Great apes (Orangutans, Gorillas,  
Chimpanzees, Bonobos and **Humans**)

Lesser apes (Gibbons)

# Strepsirrhine Traits

- ▣ Rhinarium (Wet nose)
- ▣ Dental (Tooth) Comb
- ▣ No post-orbital closure (post-orbital bar)
- ▣ Tapetum lucidum
- ▣ Grooming claw
- ▣ Unfused mandible



# Strepsirrhines

- ▣ Divided into two infraorders
  1. Lemuriformes (lemurs)
  2. Lorisiformes (lorises and galagos)





# Lemuriformes

## Four major groups

- ▣ **Cheirogaleidae**
  - mouse lemurs, dwarf lemurs
- ▣ **Lemuridae**
  - true lemurs, ruffed lemurs, bamboo lemurs
  - Ring-tailed lemurs
- ▣ **Lepilemuridae**
  - sportive lemurs
- ▣ **Indriidae**
  - sifakas, indris
- ▣ **Daubentoniidae**
  - Aye Aye

➤ Diversity in size and locomotion

Indri



Sifaka



Red-tailed sportive lemur



Aye Aye



Ring tailed lemurs



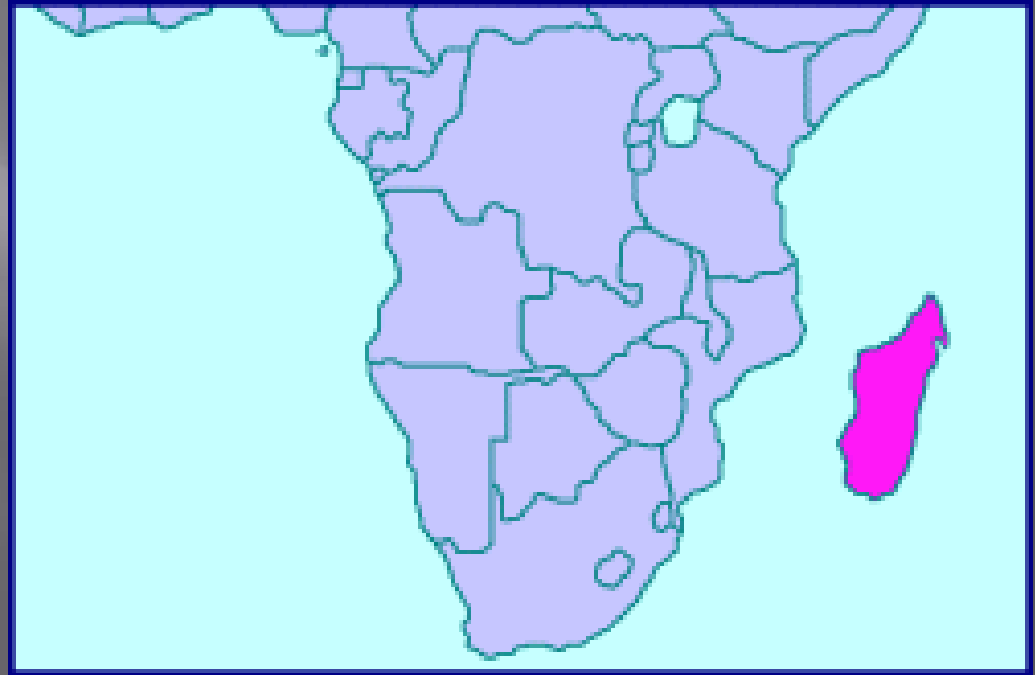
Mouse lemurs  
(*Microcebus*)

# Where are all lemurs located????



# Madagascar

- ▣ Lemurs found only on Madagascar
- ▣ 5% of world's plant and animal species
- ▣ 90% endemic
- ▣ Diverse ecology



# Strepsirrhines

## Lorisiformes (lorises and galagos)

- ▣ Small, arboreal, nocturnal

Lorises :

- slow climbers
- Africa and Asia



Slow loris

Galagos (Bush babies):

- vertical clingers and leapers
- Africa



*Galago*

# Lorisiformes

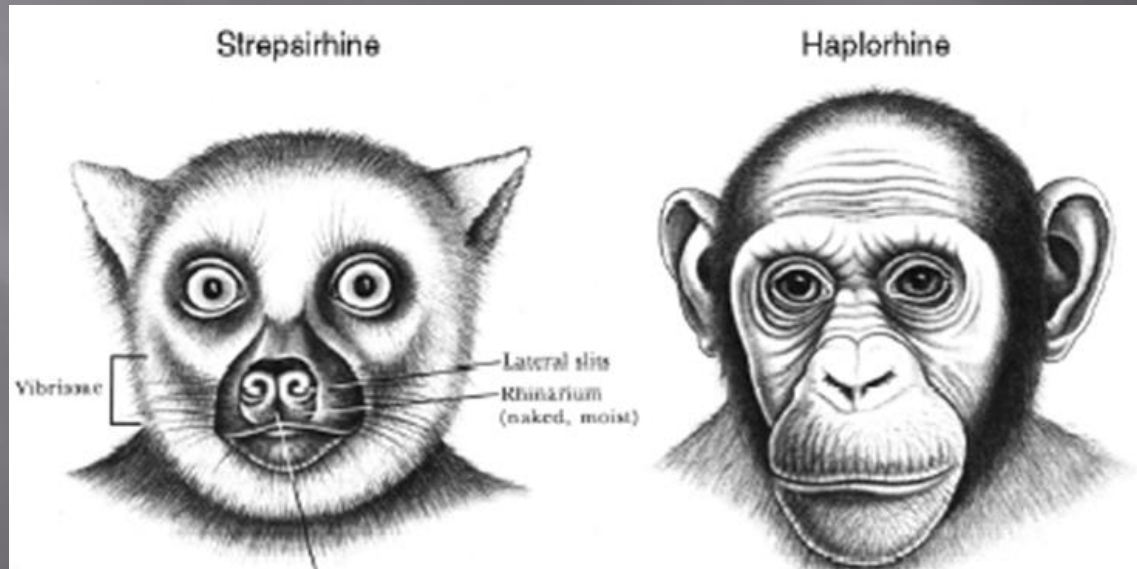
Geographic distribution



# Primate Systematics

## STREPSIRRHINES

- Rhinarium
- split upper lip
- tapetum lucidum
- Toothcombs
- post-orbital bar



## HAPLORHINES

- **no** rhinarium
- **continuous** upper lip
- **no** tapetum lucidum
- **no** toothcombs
- post-orbital plate or closure

# Haplorhines

Divided into

1. Tarsiiformes (Tarsiers)

2. Anthropoids (monkeys and apes / Platyrrhines and Catarrhines )





## Tarsiers

-Small, nocturnal,  
insectivorous

-Vertical clingers and  
leapers

-no toothcombs or  
tapetum lucidum

-post-orbital plate

-unfused mandible





# Tarsiers



- ▣ Found in South East Asia.
- ▣ Very primitive Haplorhines.

# Anthropoids

## Catarrhines and Platyrrhines

- Post orbital closure
- Fused mandibular symphysis

\*different from Tarsiers



-Anthropoids (Platyrrhines and Catarrhines)

Platyrrhines (New World Monkeys)

- Arboreal, live in tropical forests
- Arboreal quadrupeds and some suspensory climbers
- Three premolars
- Five different families

Tamarins



Marmosets



squirrel monkey



Capuchin



owl monkey



Ucari monkey



titi monkey

1. Callithrichidae (Marmosets and Tamarins)
2. Cebidae (Capuchin and squirrel monkeys)
3. Aotidae (owl monkeys)
4. Atelinae (titi monkeys)
5. Pitheciidae (Ucari monkeys)

# -Anthropoids (Platyrrhines and Catarrhines)

## Catarrhines

- Old World monkeys and apes
  - Humans are catarrhines
  - Geographic Range: Africa and Asia (Old World)
  - Larger body size and more diverse habitats than platyrrhines
  - Two premolars
- Catarrhines divided into:
- Old World monkeys (Cercopithecoids)
  - Apes (Hominoids)



# Catarrhines: Cercopithecoids

## Old World Monkeys

- Geographic range: Africa and Asia
- Diversity in size, habitats, diet
- Large groups - male dispersal, female bonds
- Divided into two groups

### 1. Cercopithecines

→ baboons, macaques, vervet monkeys, mandrills, drills

### 2. Colobines

→ black-and-white colobus monkey, proboscis monkey, gray langurs



Black and white Colobus monkey



Vervet

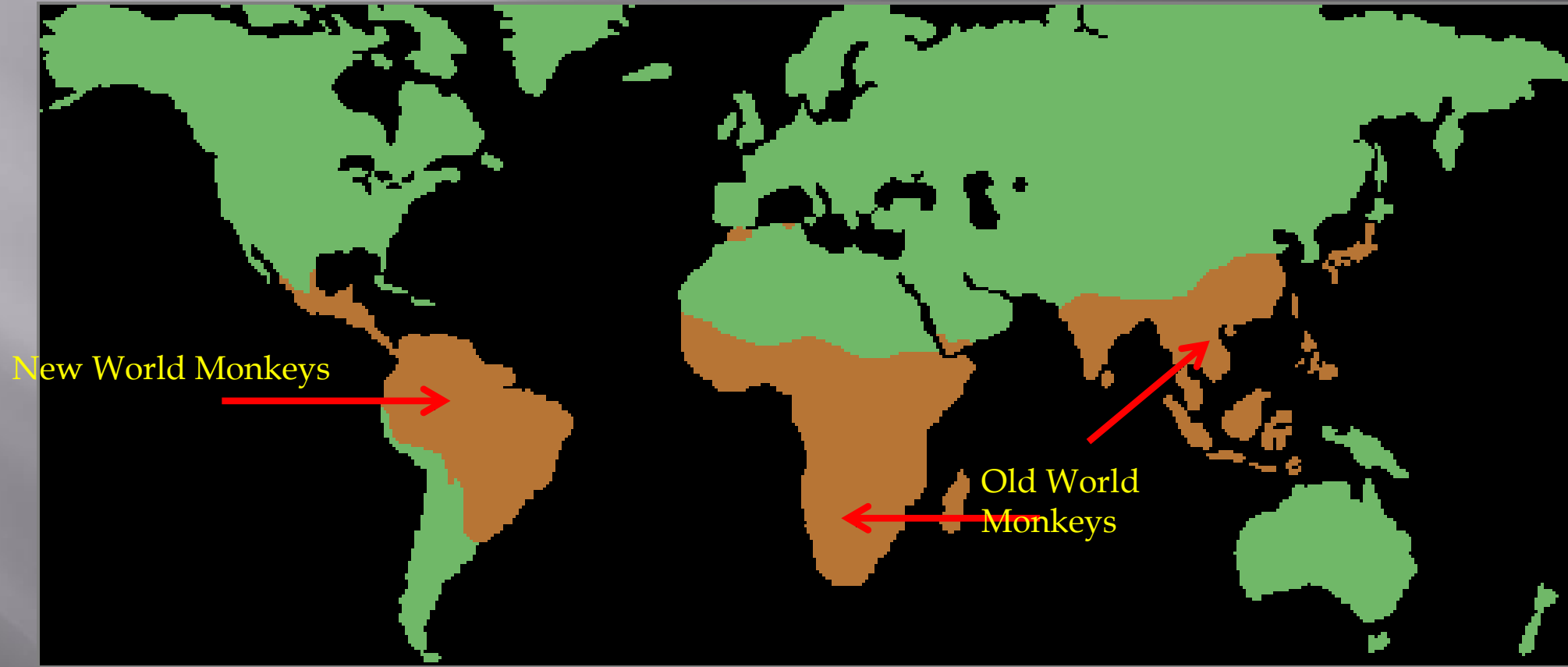


Gray langur



Proboscis monkey

# Distribution



# Catarrhines: Hominoids

## -Apes (Hominoids)

Hominoids:

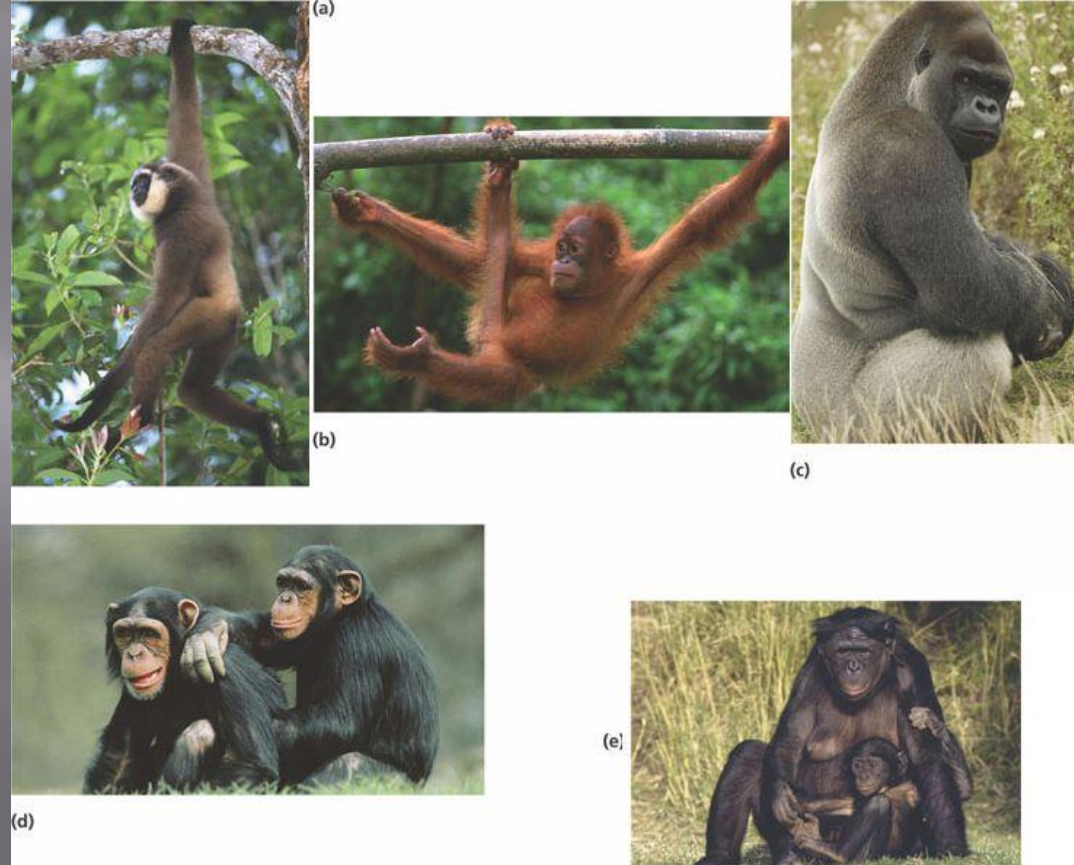
-Relatively large brains

-Tail-less

-Suspensory, orthograde climbers  
\*orthograde vs pronograde

Divided into

1. Lesser apes (Hylobatidae)
2. Great apes (Hominidae)



# Hominoids: Hylobatidae

Hylobatids:

- Gibbons and Siamangs
- Asian apes
- Very long arms, arboreal, brachiators
- Pair bonding; male parental care in siamangs
- Territorial duets



Gibbons



Siamangs



# Hominoids: Hominidae

## Family Hominidae:

Orangutans (*Pongo*)

Gorillas (*Gorilla*)

Chimpanzees

Bonobos

} (*Pan*)

Humans (*Homo*)



# Orangutan (*Pongo*)

## Orangutan

-Genus *Pongo*

-Geographic Range: Borneo and Sumatra

-Largest arboreal animal in the world

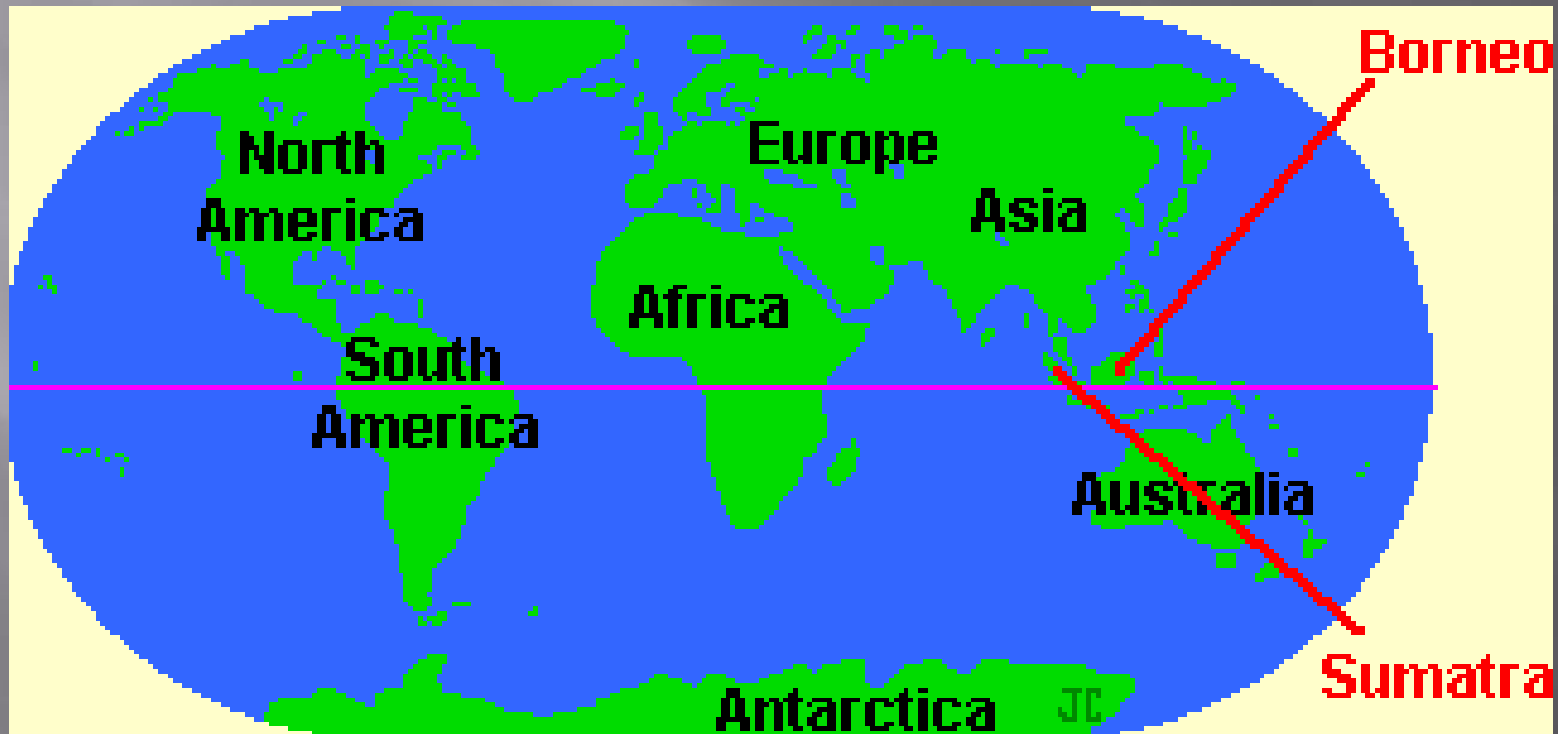
-Eats fruit, leaves, and bark

-Relatively solitary

-Intense male-male competition for mates



# Distribution of Orangutans



# Gorilla (*Gorilla*)

## Gorilla

- Genus *Gorilla*
- Geographic Range: Equatorial Africa
- Largest of the apes
- Tend to live in one-male (Silverback is the dominant male) , multi-female groups
- Eats mixed vegetation, fruit if available
- Knuckle walkers
- Mountain and lowland gorilla



# Bonobo (*Pan*)

## Bonobo

-Genus *Pan*

“Pygmy chimpanzee”  
(misleading)

-Geographic Range:  
Small area in the Congo

-Multimale, multifemale  
groups;  
female dispersal

-Diet of fruit, vegetation, some  
Meat

- Strong female social bonding



# Chimpanzee (*Pan*)

## Chimpanzee

-Genus *Pan*

-Geographic Range: Equatorial Africa

-Multimale, multifemale groups; female dispersal

-Strong male social bonding

-Eats fruit, vegetation, meat

-Knuckle walkers

-Sophisticated tool use



bonobo



chimpanzee

## Differences:

Level of dimorphism

Appearance (i.e., lip coloration)

Social Structure

Sexual behavior

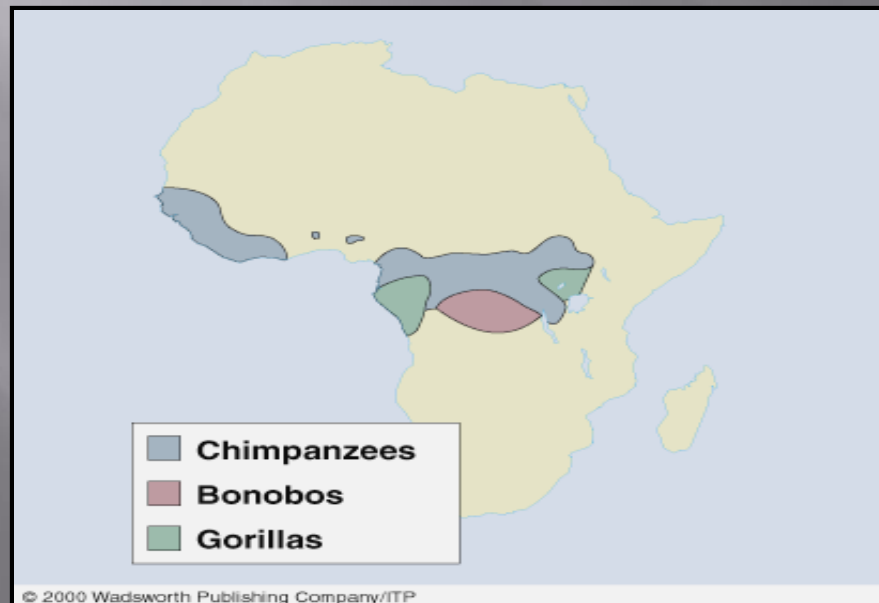
Vocalization

Tool use

# Distribution

## ▣ Africa

- ▣ gorillas
- ▣ chimpanzees (and bonobos)



## ▣ Asia

- ▣ gibbons
- ▣ orangutans





# Human (*Homo*)

## Humans

- Homo sapiens* (Genus, species)
- Global species
- Diversity in social and mating organization, though tend to pair bond
- Diversity in diet, though primarily omnivorous
- Complex verbal language
- Bipedal, large-brained
- Sophisticated tool use



