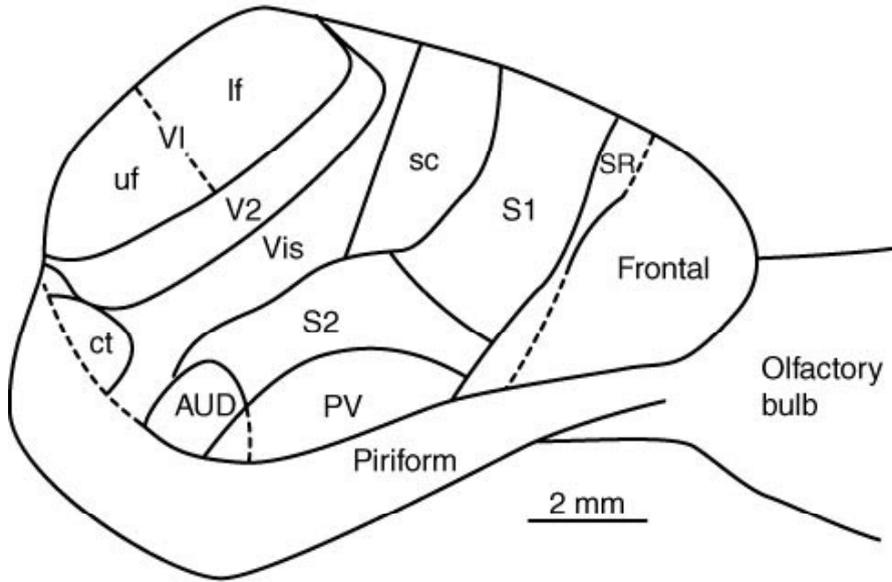
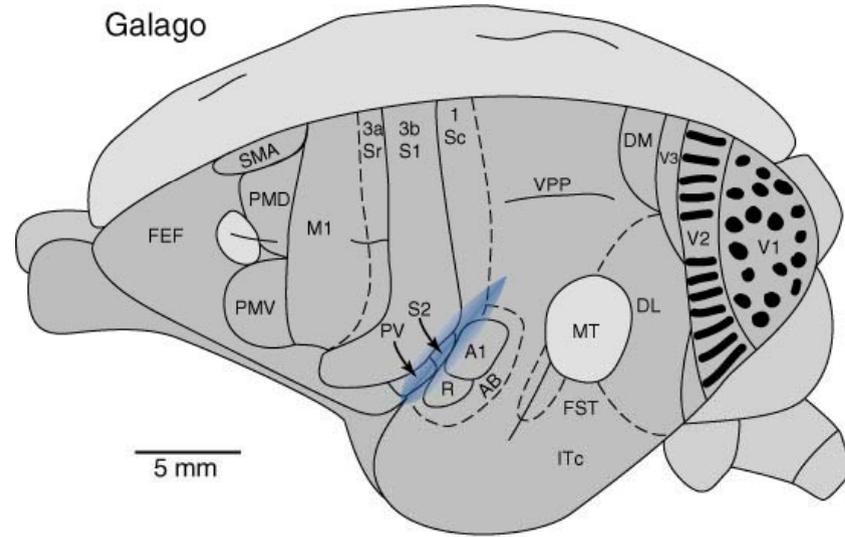


Opossum cortical areas

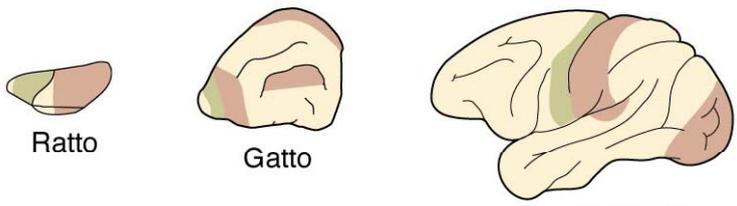


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Galago



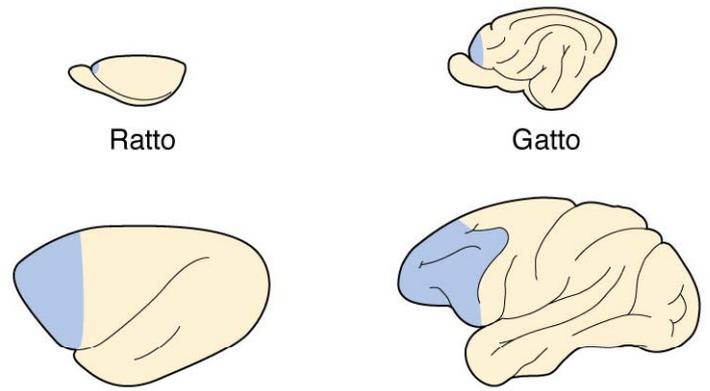
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Ratto

Gatto

Scimmia

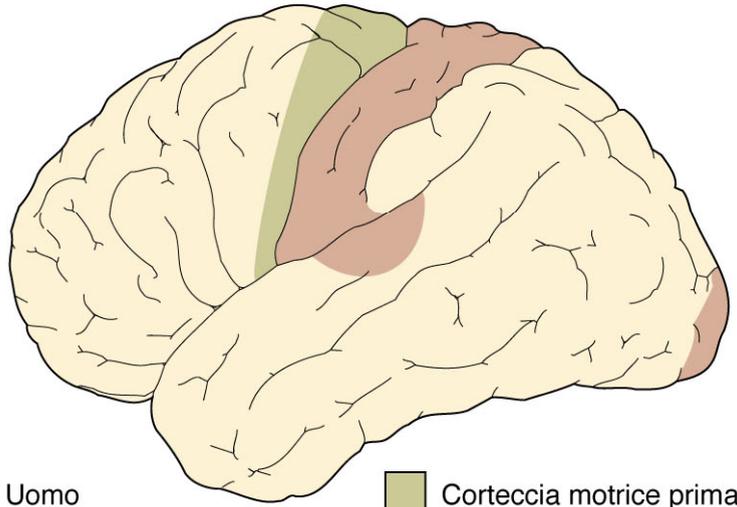


Ratto

Gatto

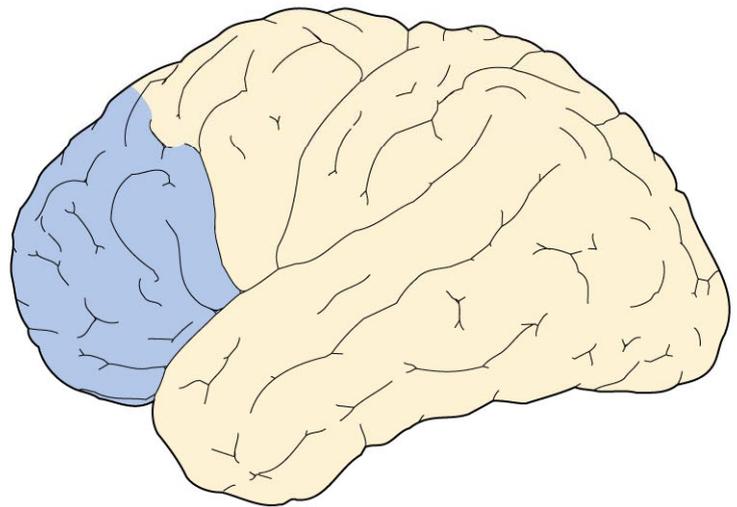
Nictipiteco

Macaco Rhesus

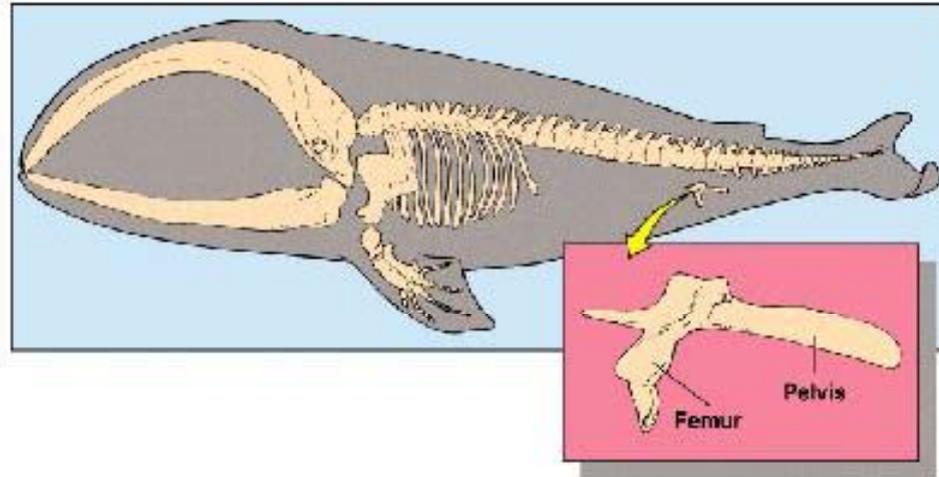
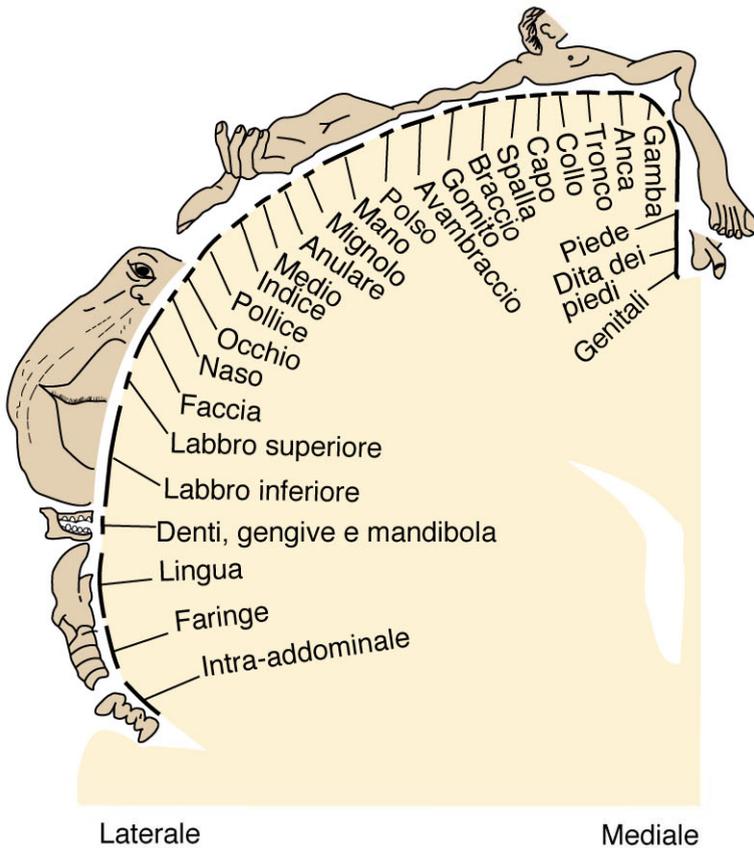
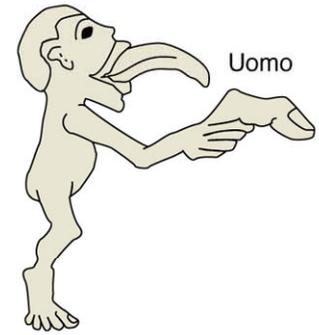
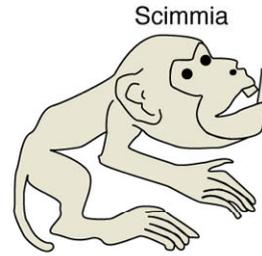
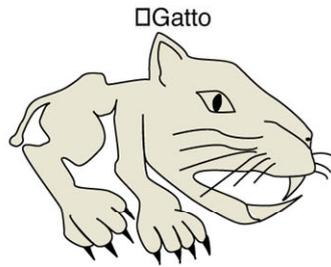
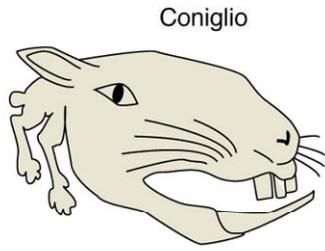


Uomo

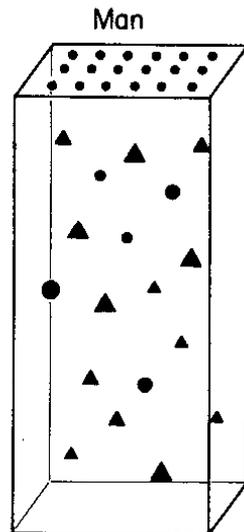
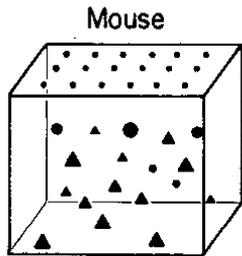
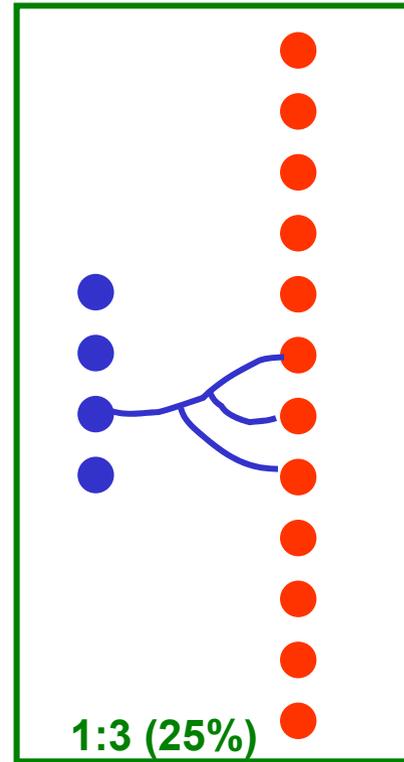
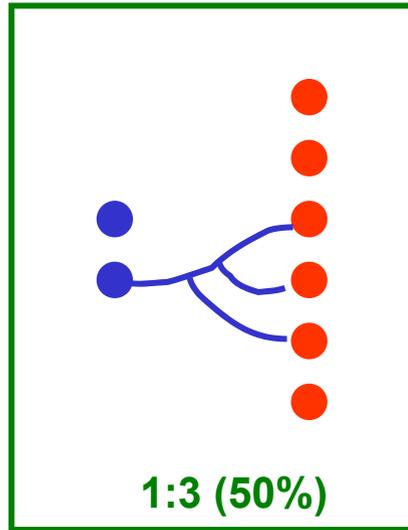
- Corteccia motrice primaria
- Corteccia somatosensitiva primaria
- Cortecce sensoriali d'ordine superiore e cortecce associative



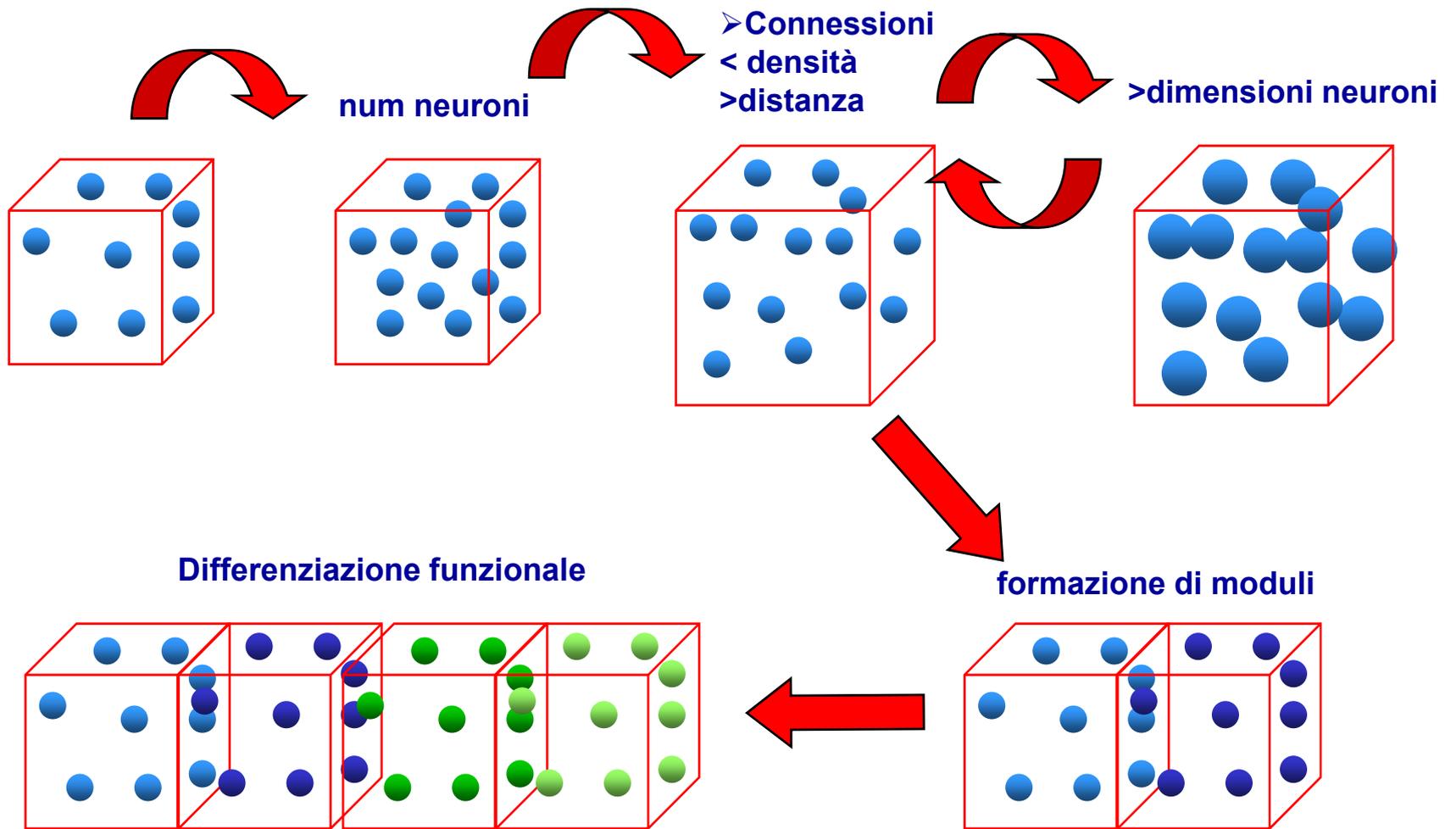
Uomo



Se aumenta il numero dei neuroni, per mantenere lo stesso rapporto fra le diverse popolazioni deve aumentare il numero delle connessioni

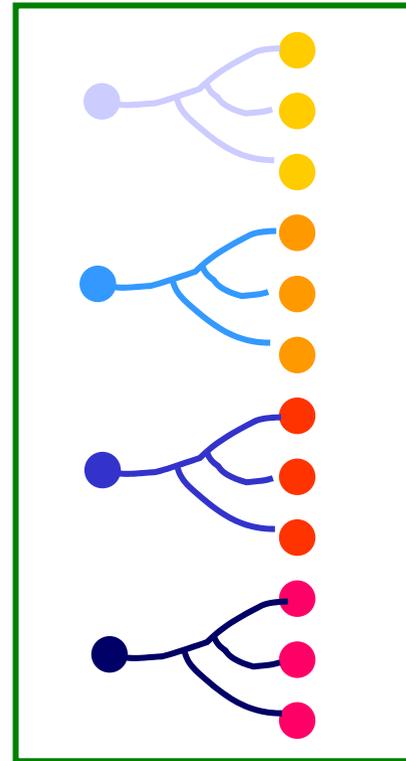
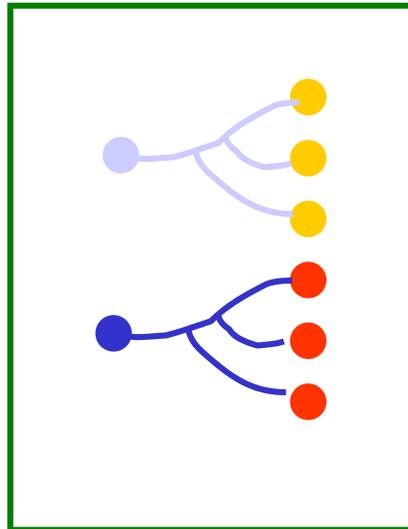


In effetti, specie con cervelli più grandi hanno una minore densità di cellule e un maggior numero di connessioni

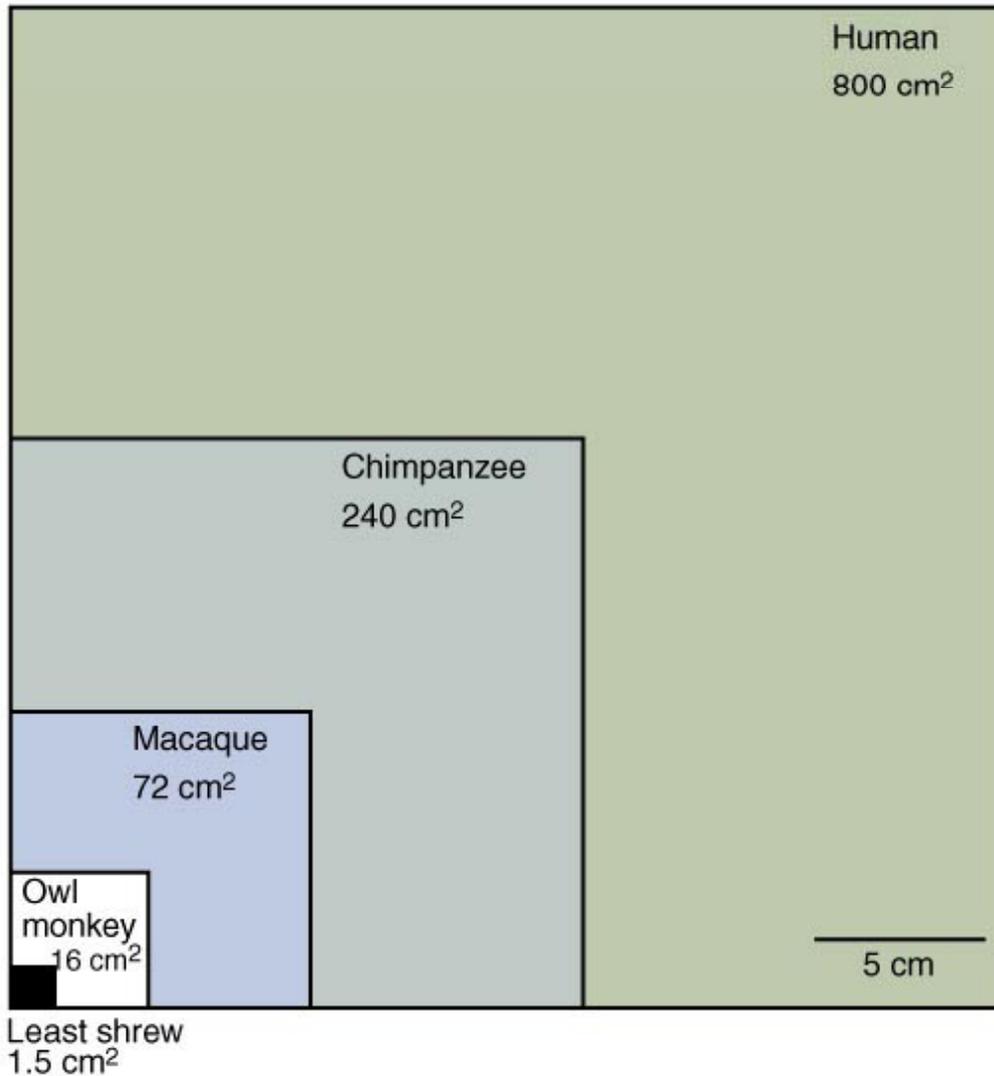


Per costruire un cervello più grande:

- Aumentare le **dimensioni dei neuroni** e dei processi (dendriti, assone)
- Diminuire la **proporzione di connessioni** fra i neuroni di una popolazione e quelli di un'altra
- Aumentare la **modularità del cervello**, limitando le distanze fra neuroni che interagiscono e riducendo al minimo l'incremento di dimensione dei neuroni. La creazione di nuovi moduli può favorire la comparsa di nuove proprietà funzionali



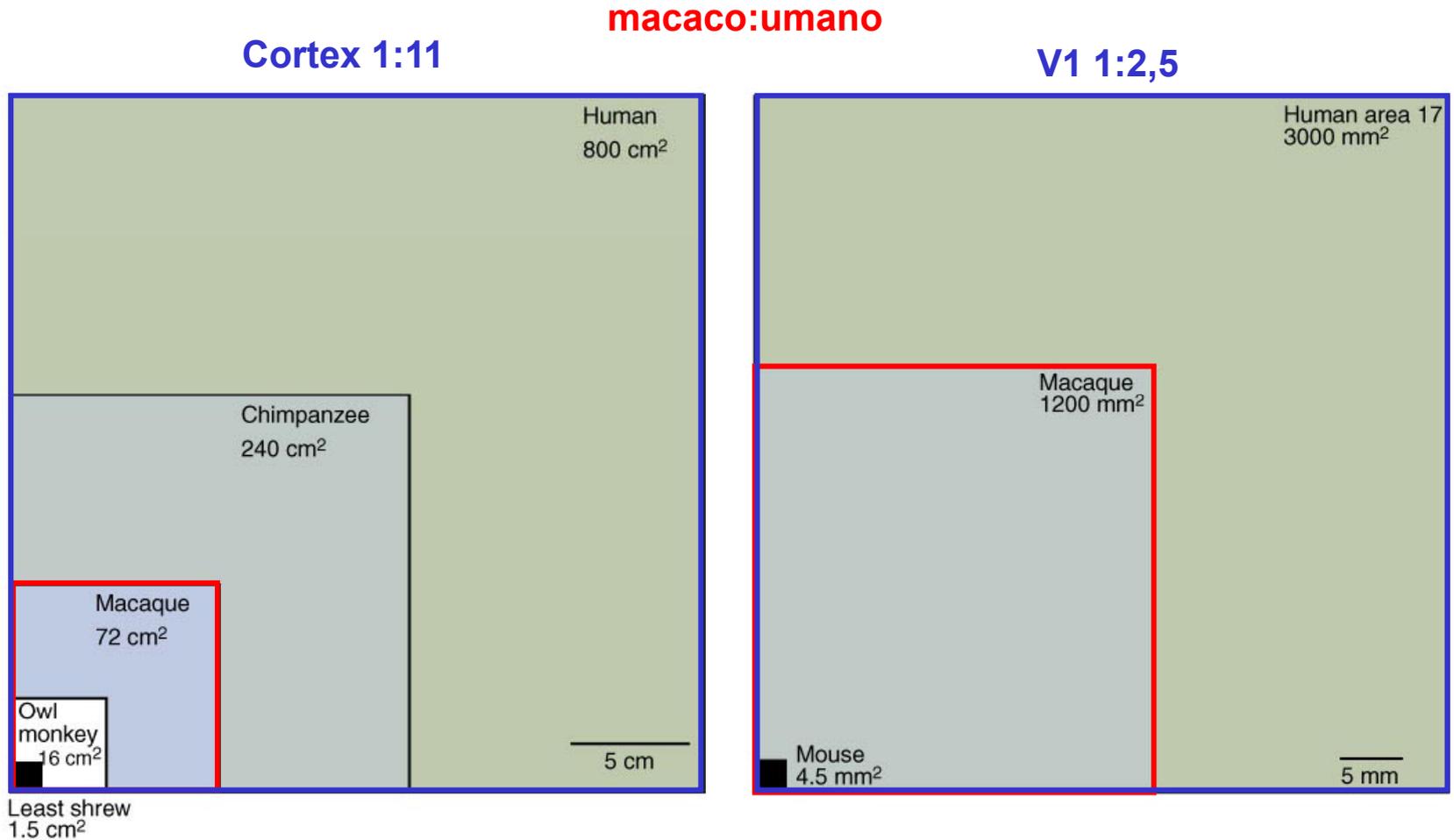
Aumento di dimensione della neocorteccia



Aree corticali più grandi

Aree corticali più numerose

L'incremento di dimensione delle singole aree corticali non è proporzionale a quello dell'intera corteccia



C'è un limite anche all'incremento dimensionale delle singole aree corticali

Effetti delle variazioni di dimensioni delle aree corticali sull'elaborazione effettuata da singoli neuroni

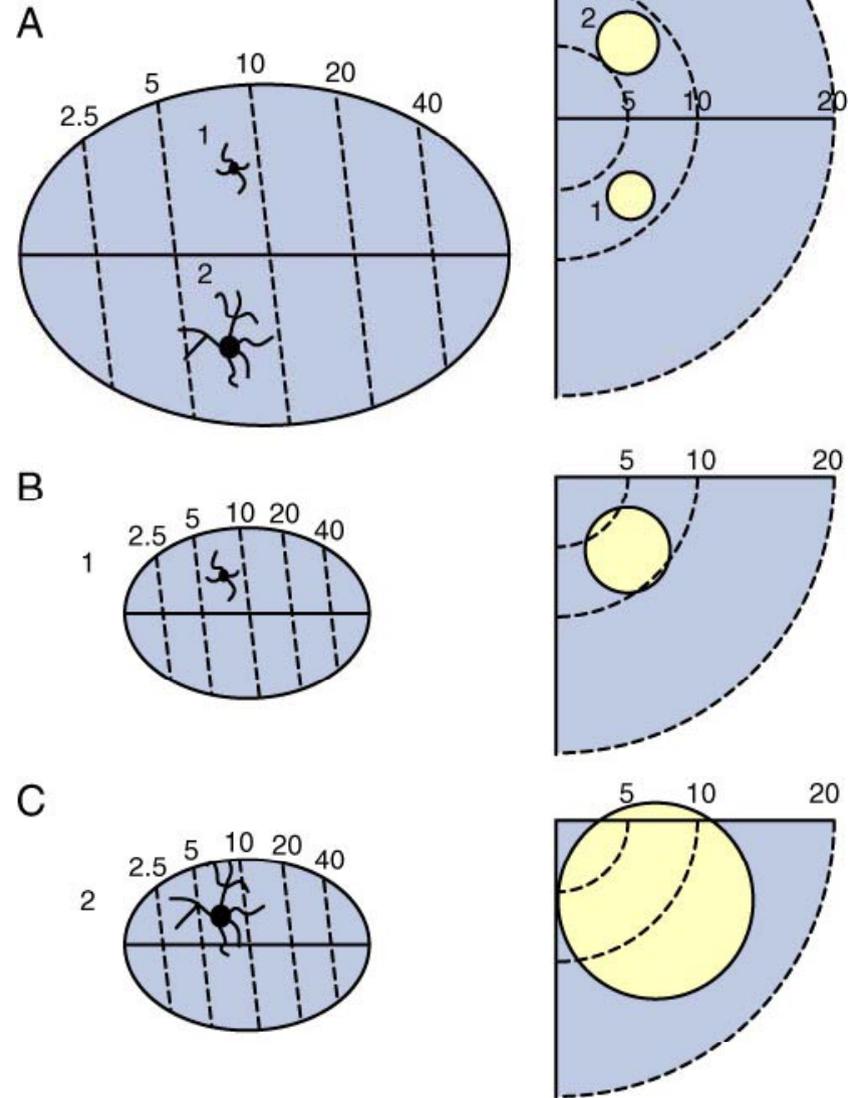
Nell'area V1:

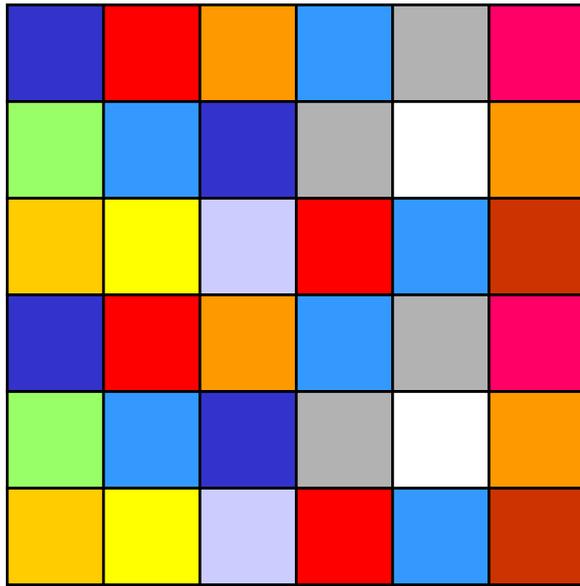
Aumentando le dimensioni dell'area si riducono quelle dei campi recettivi dei singoli neuroni

Di conseguenza ogni neurone "vede" una regione più ristretta di campo visivo

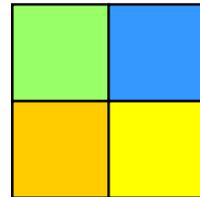
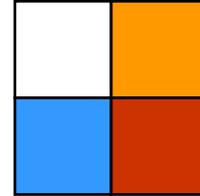
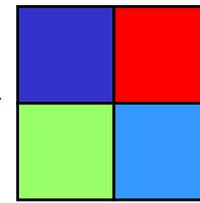
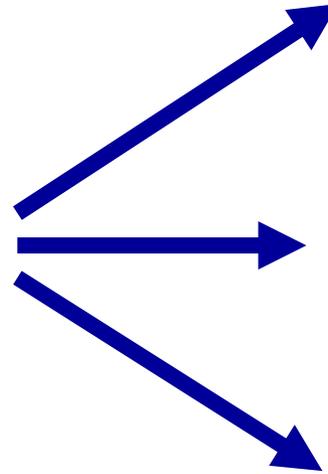
L'area diviene così frammentata in moduli funzionali (colonne, ipercolonne) più piccoli

Ogni modulo elabora informazioni "locali" con un incremento della risoluzione spaziale, ma a scapito di una elaborazione globale del segnale sensoriale





Area primaria grande
Molti moduli
elaborazione locale



Aree secondarie piccole
Pochi moduli
elaborazione globale

Aumentando l'estensione della corteccia aumenta il numero di aree dedicate ad una funzione:

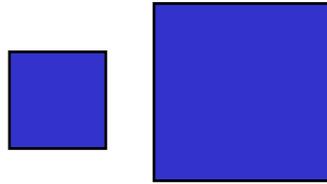
Es. aree visive:

Piccoli mammiferi
Macaco

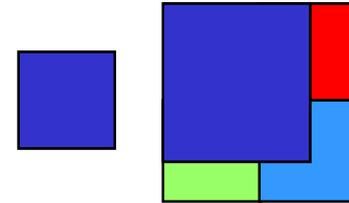
2-5
30

Soluzioni al problema dell'incremento di estensione della neocorteccia

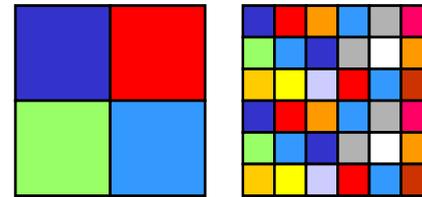
Aumento dimensioni di singole aree



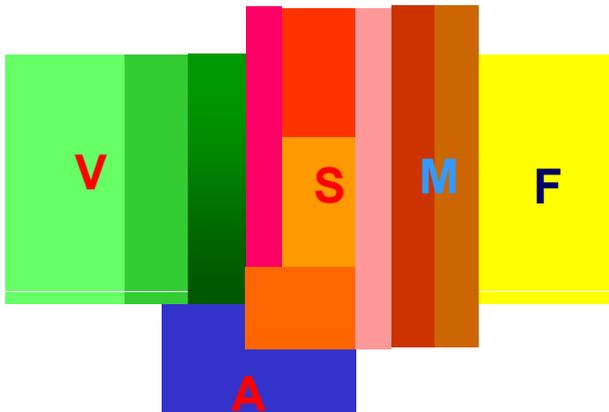
Aumento numero aree



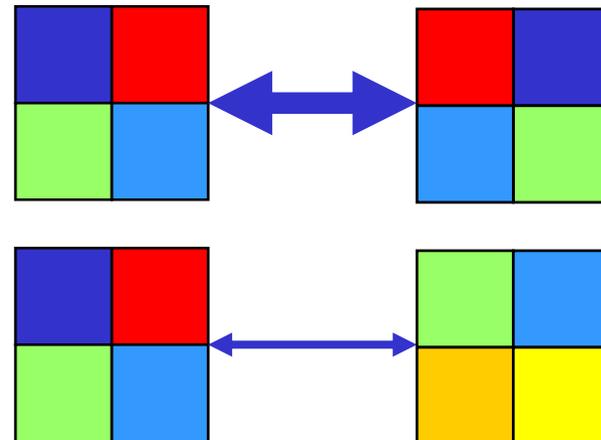
Aumento del numero di moduli funzionali (colonne)

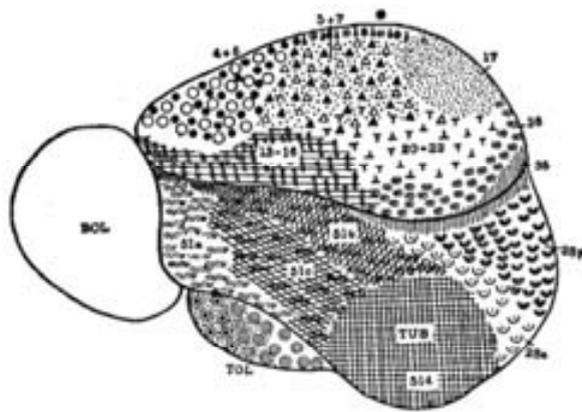


Aree funzionali omologhe sono raggruppate

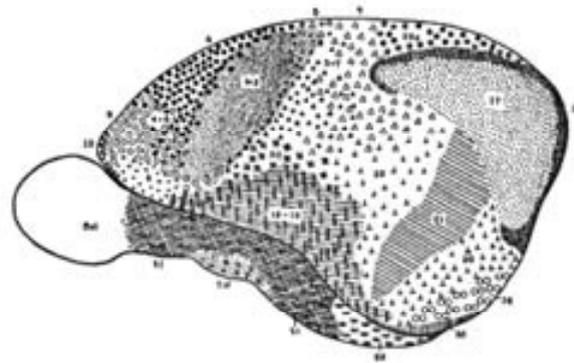


Riduzione delle connessioni interemisferiche (corpo calloso) e comparsa della differenziazione emisferica

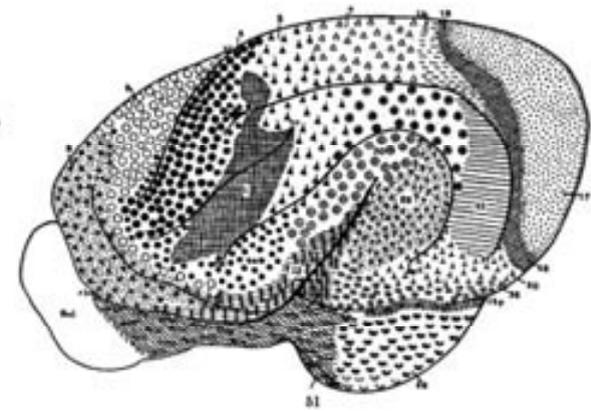




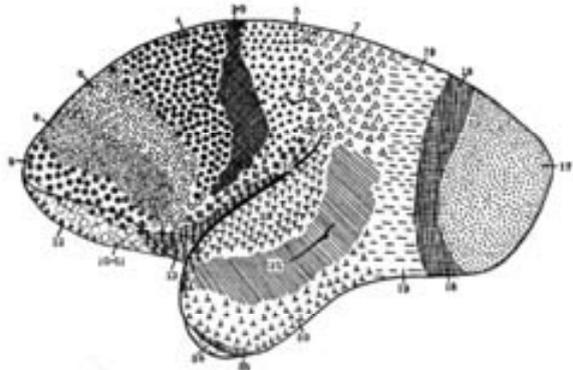
Hedgehog



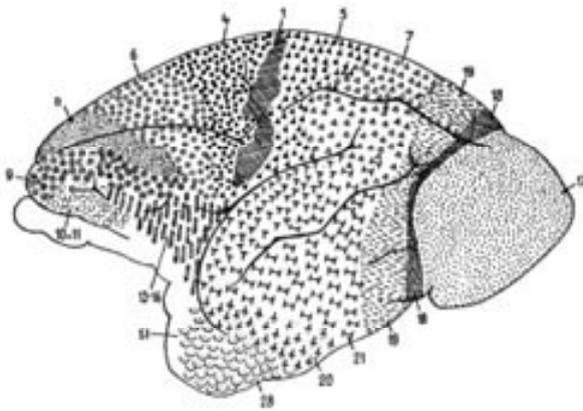
Rabbit



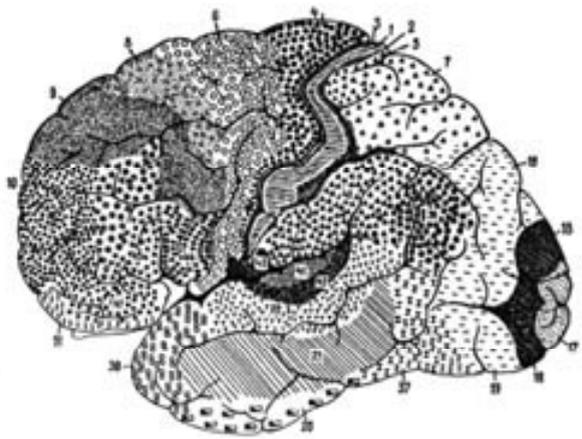
Kinkajou



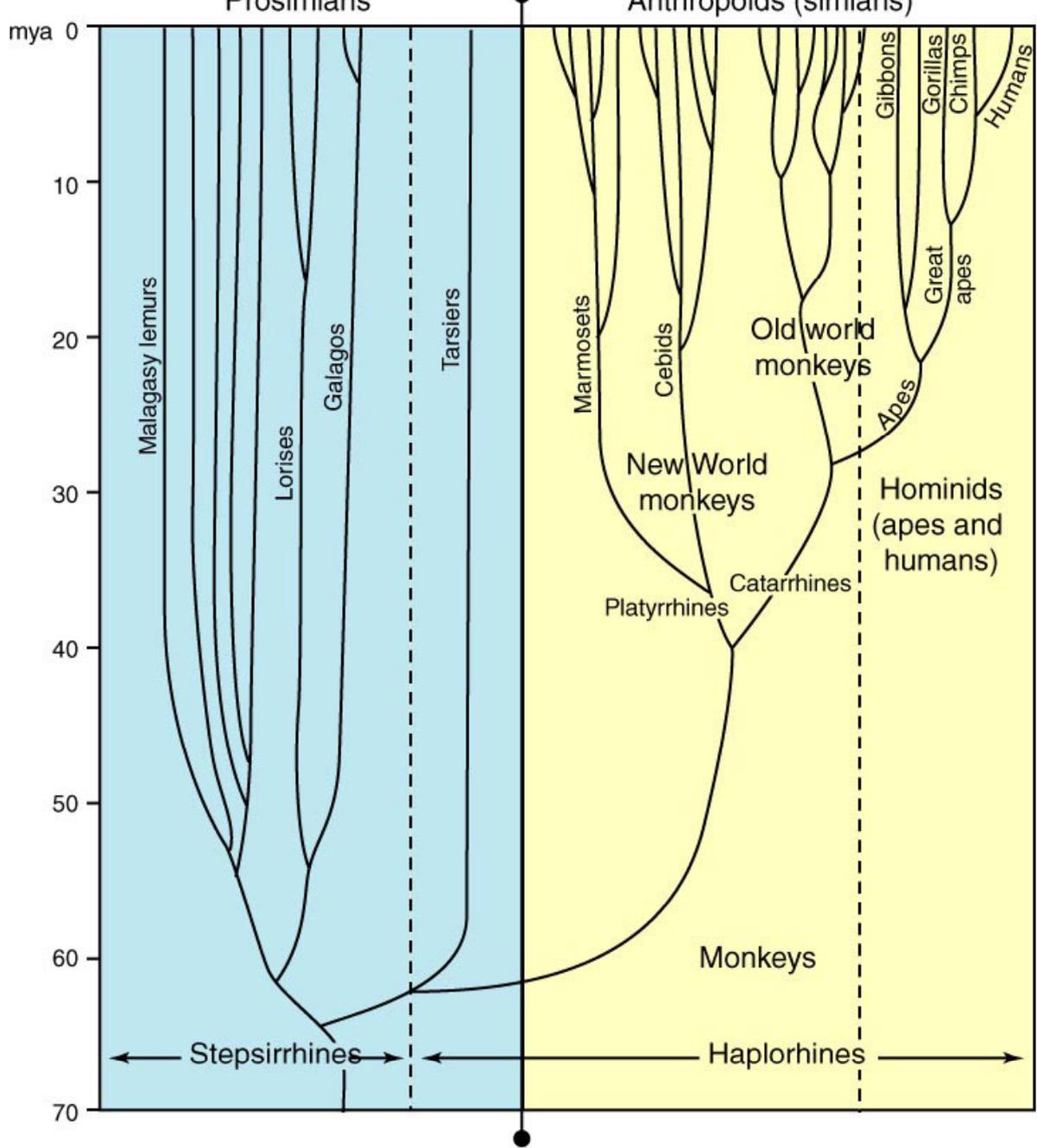
Marmoset



Lemur



Human



Evoluzione dei primati

Evoluzione divergente delle aree corticali

Evoluzione corpo calloso

Moltiplicazione delle aree unimodali e multimodali

Evoluzione della specializzazione emisferica

Primate primitivi

Arboricoli nella foresta

Mangiano insetti, frutta

Movimento fine (reaching-grasping) guidato dalla visione:

involuzione del sistema olfattivo

sviluppo visione frontale (tridimensionale)

evoluzione del sistema visivo

pollice opponente

dita coperte da unghie

inizialmente notturni, poi diurni (vita nella savana)

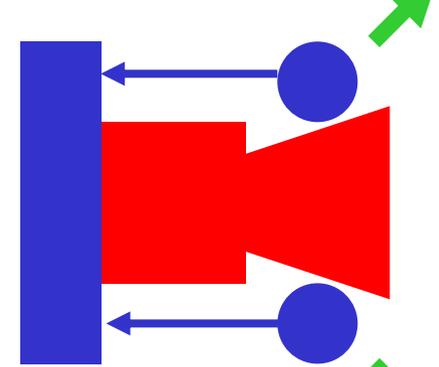
visione foveale, predominanza dei coni (acuità)

visione cromatica (dicromatica poi tricromatica)

Vita diurna: sviluppo attività sociali (protezione, ricerca del cibo)

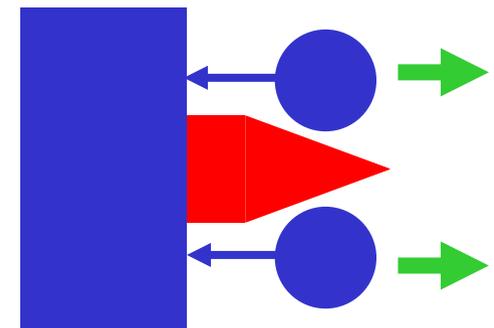
crescita regioni parieto-frontali (controllo motorio ed

interazioni sociali)

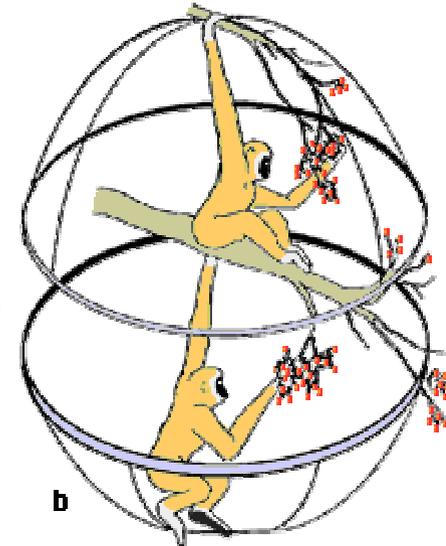
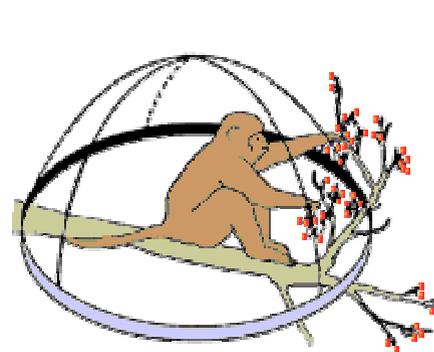
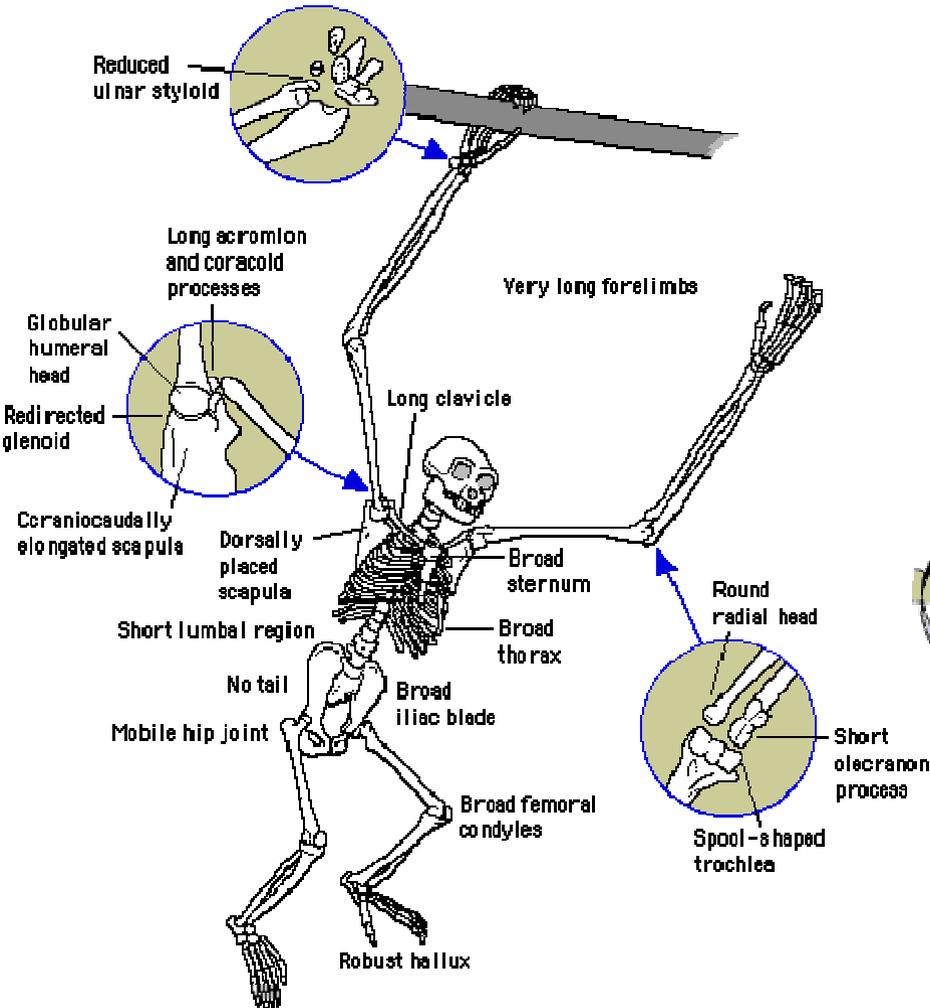


Sistema olfattivo

Sistema visivo

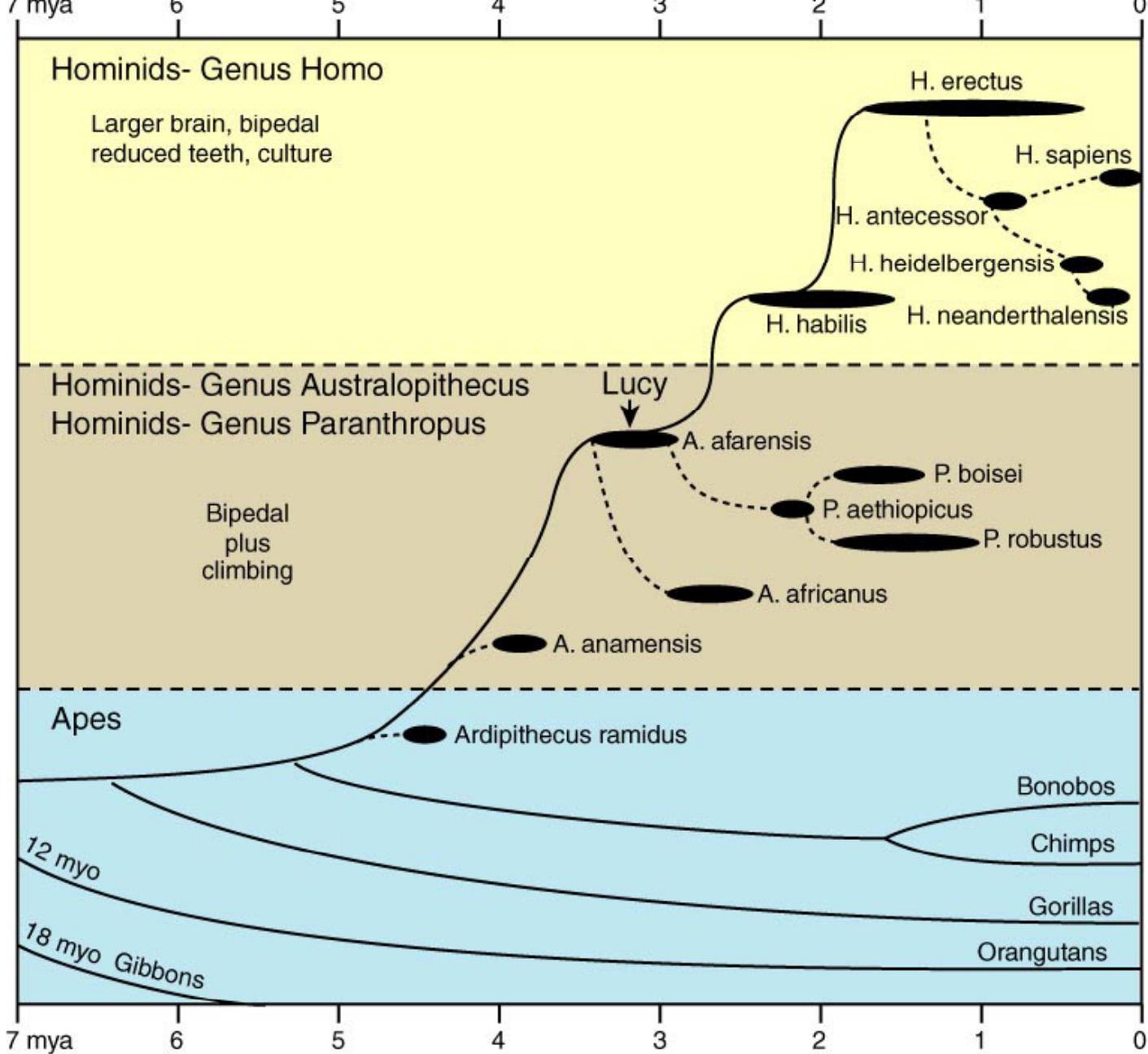


brachiazione



a

b



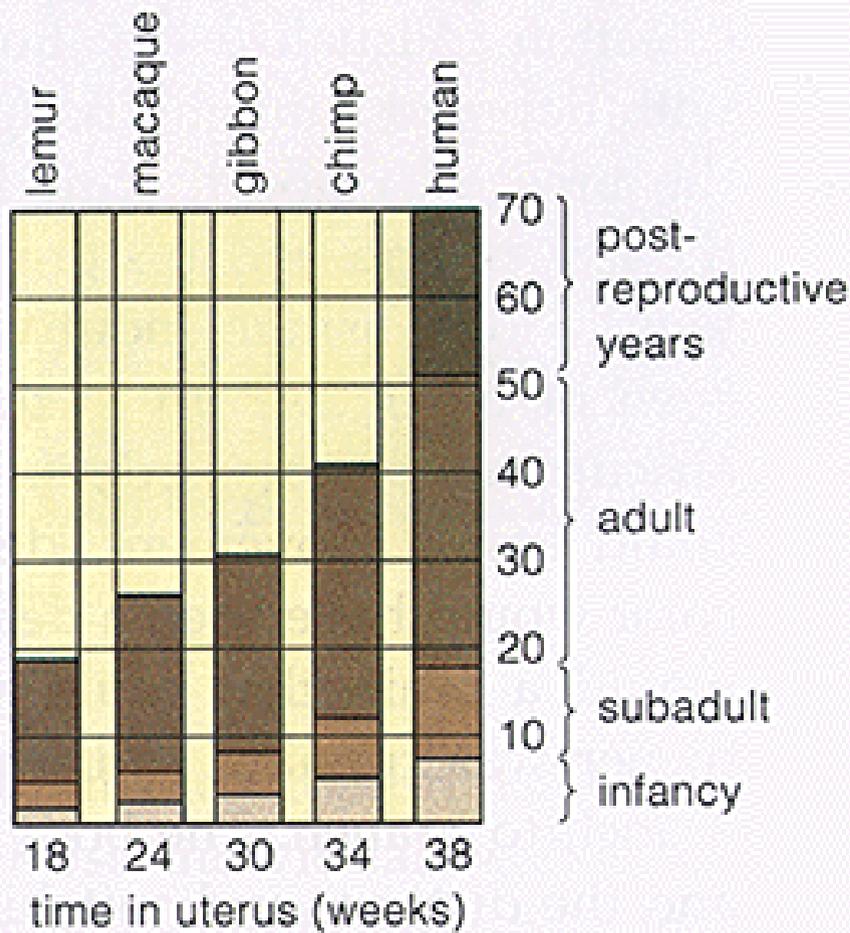
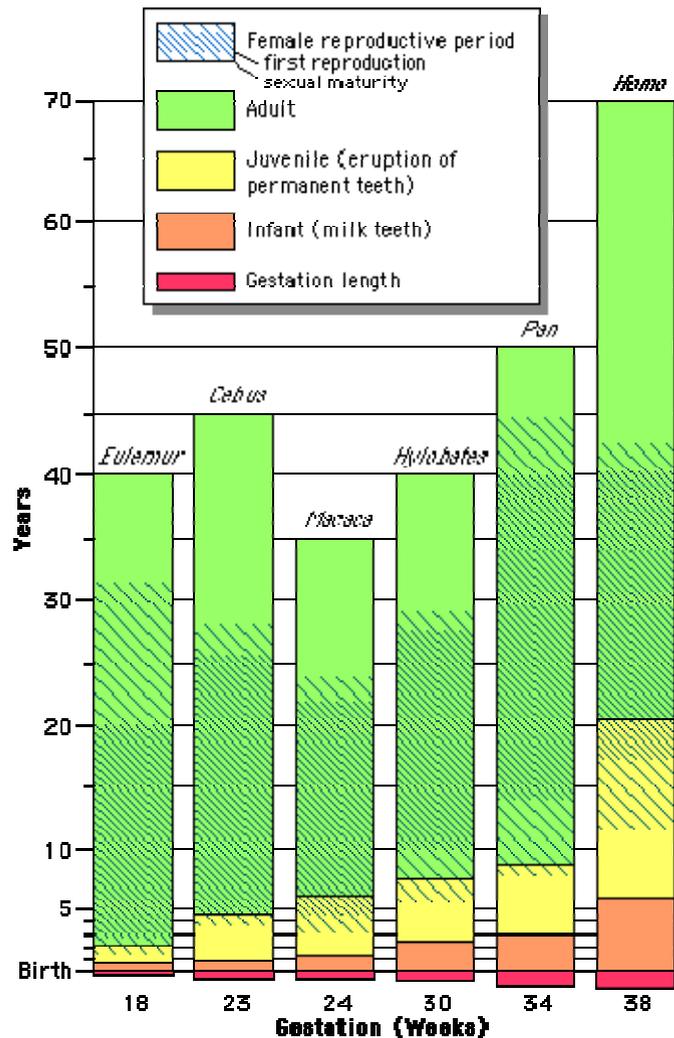
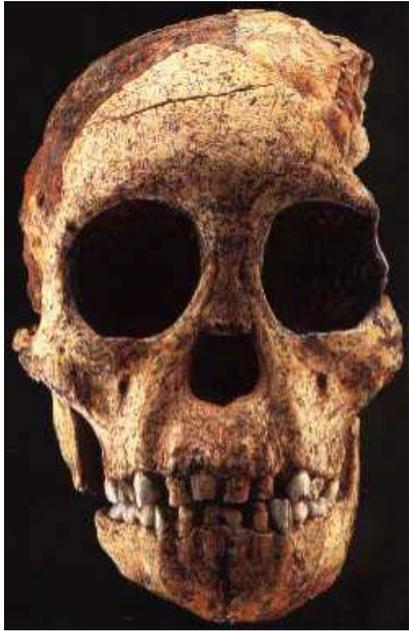


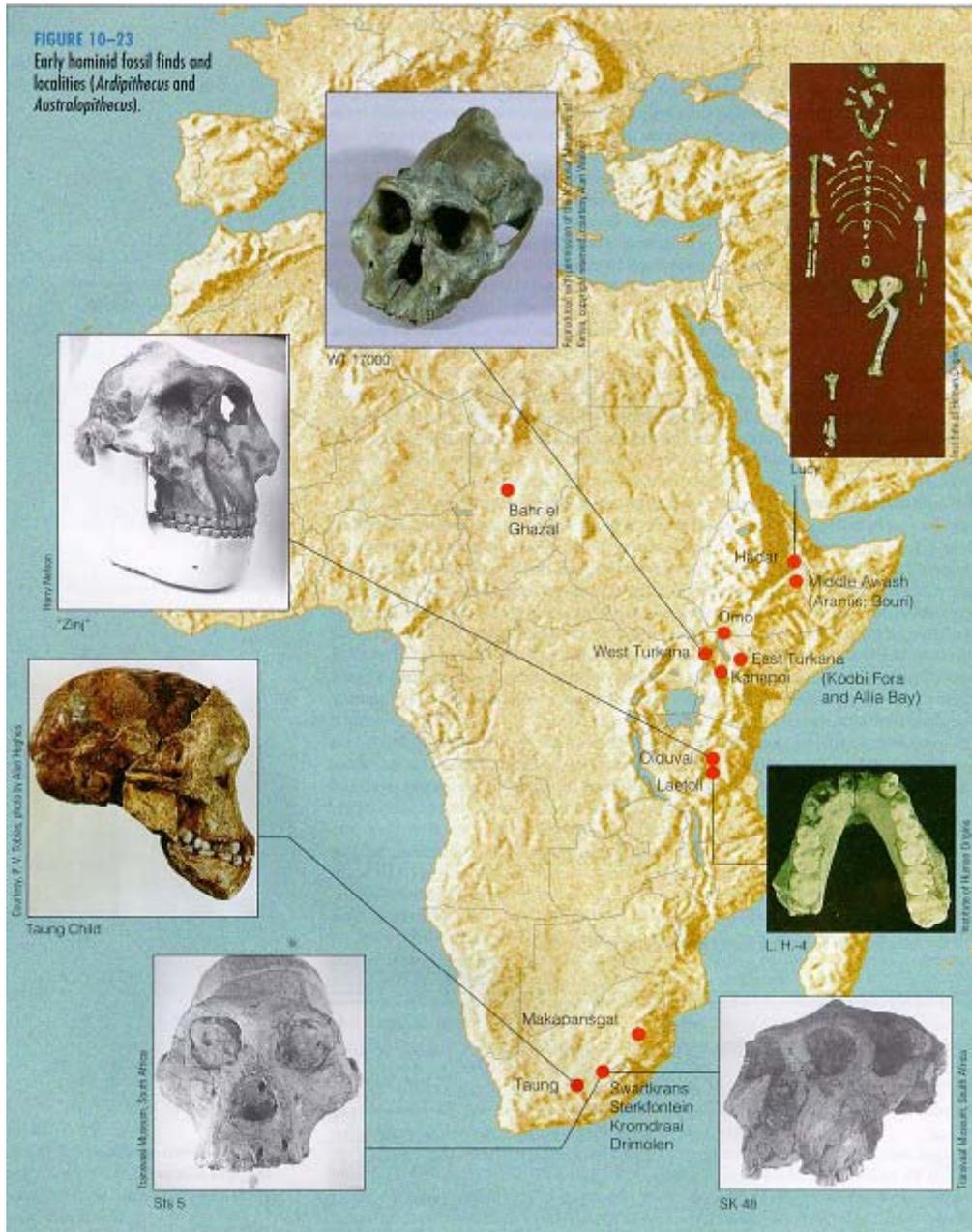
Figure 28.5 Trend toward longer life spans and longer dependency among primates.



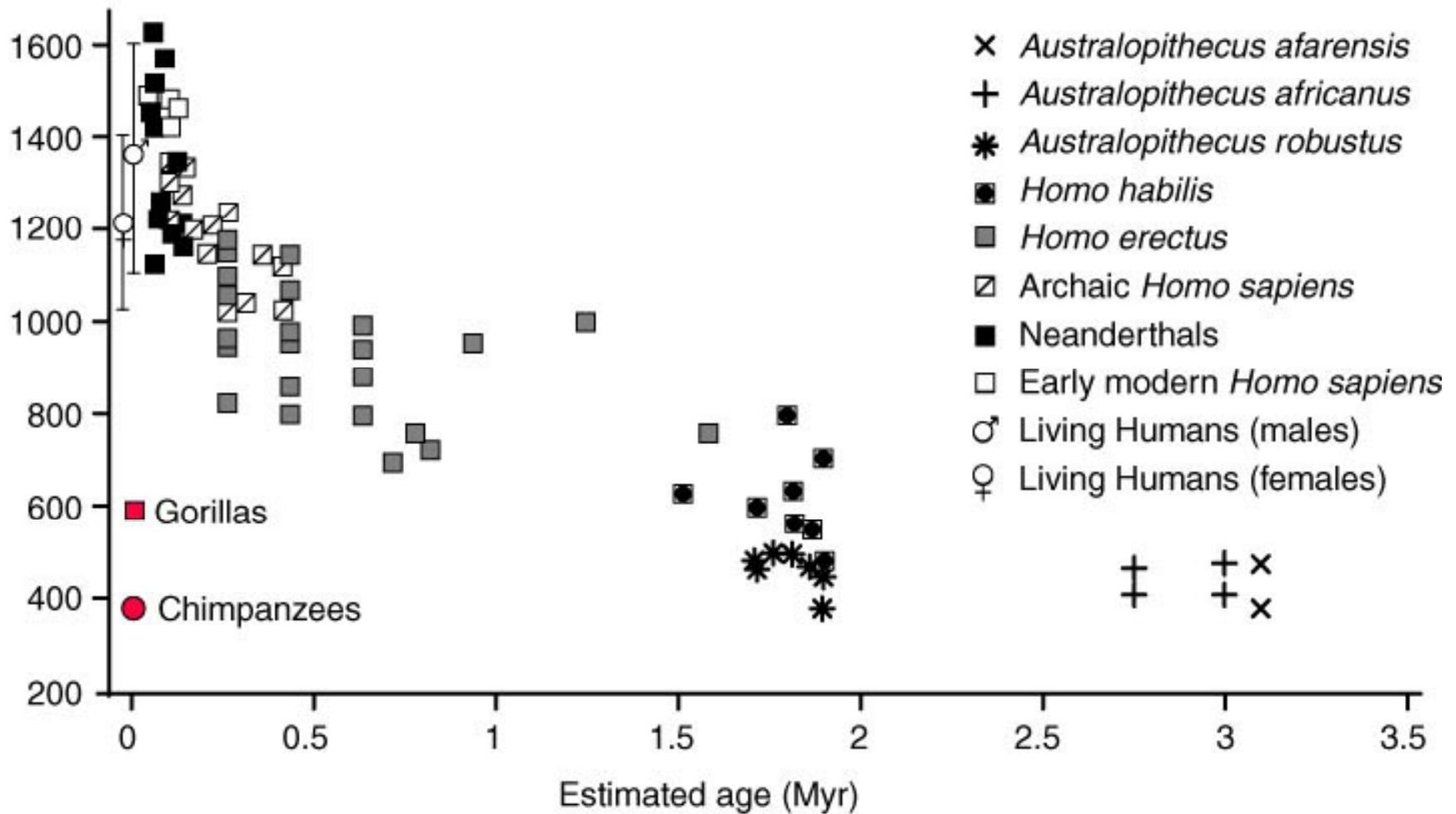


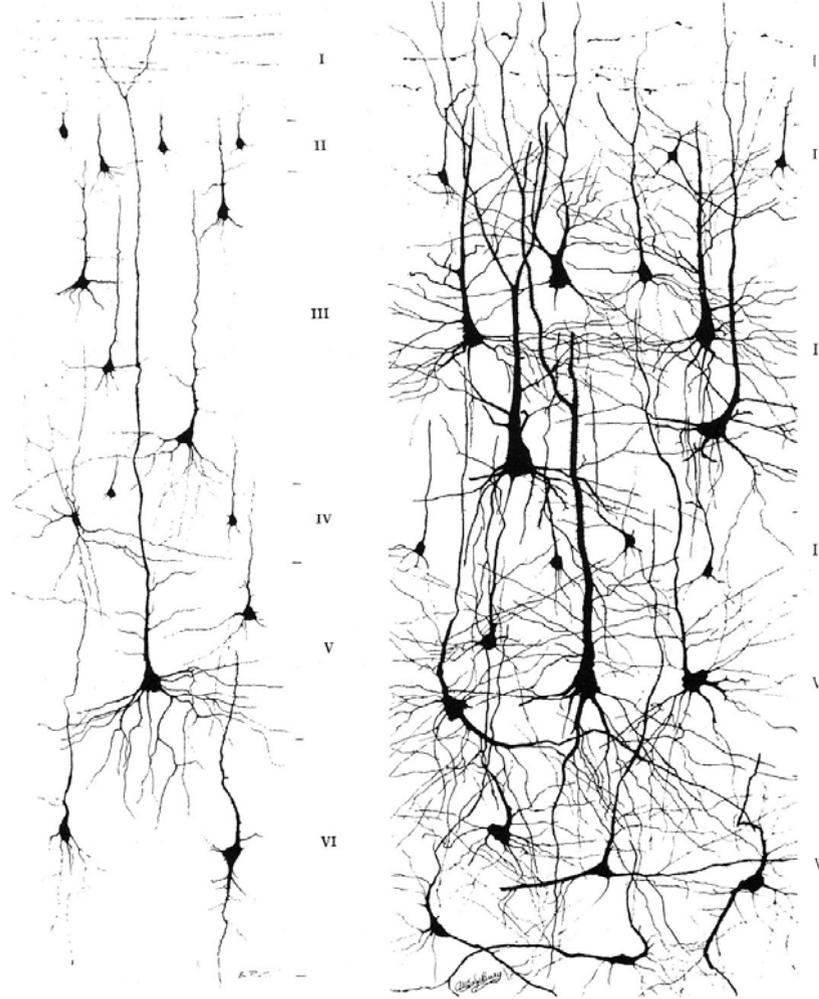
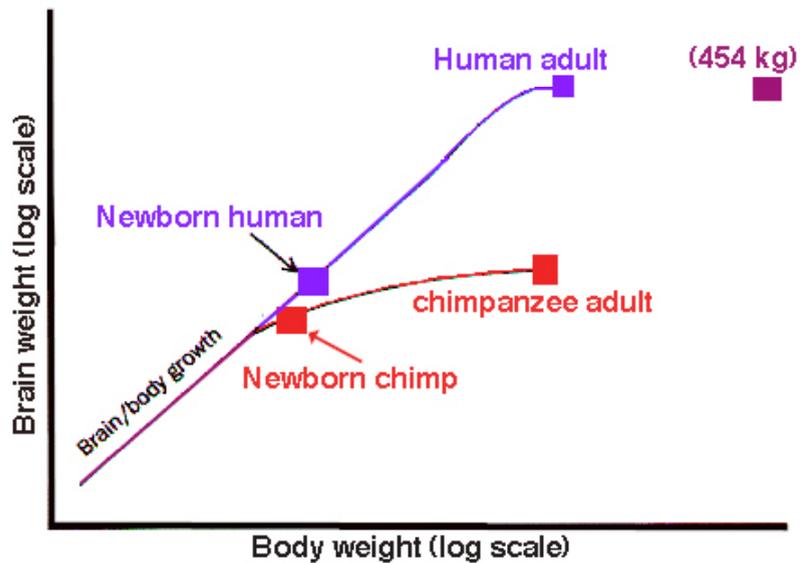
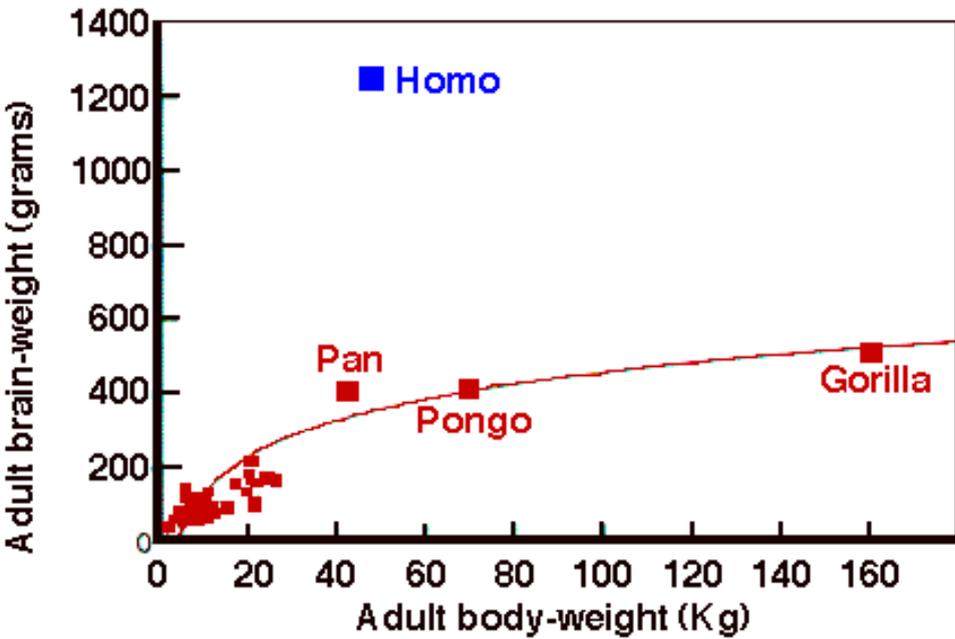
Taung child

FIGURE 10-23
Early hominid fossil finds and localities (Aralopithecus and Australopithecus).



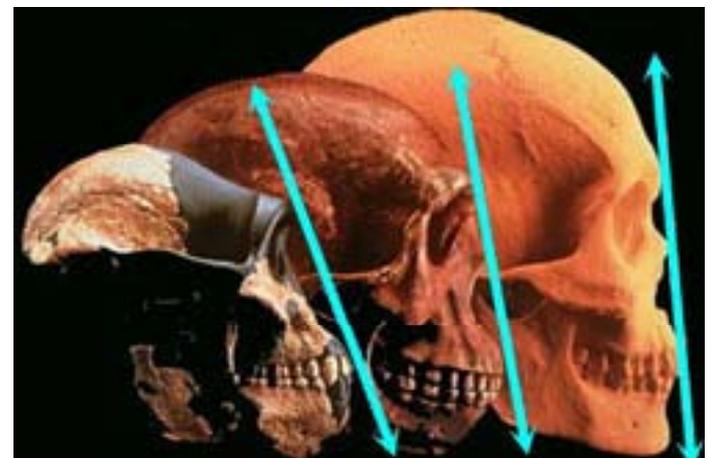
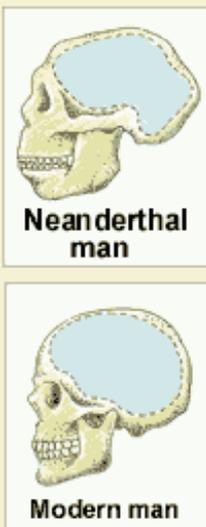
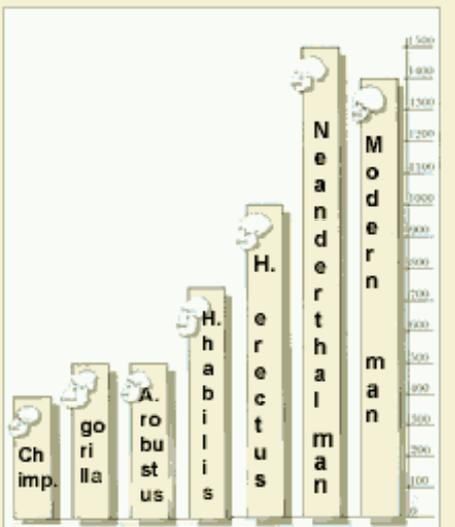
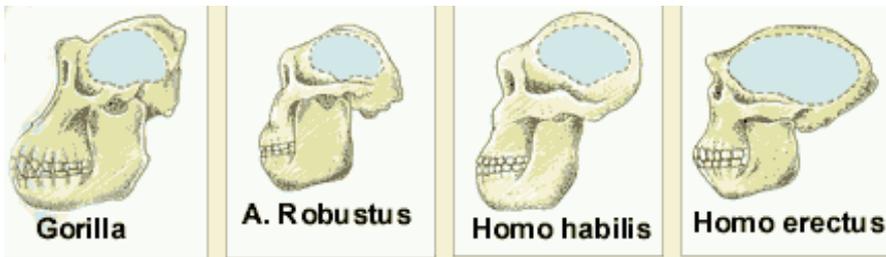
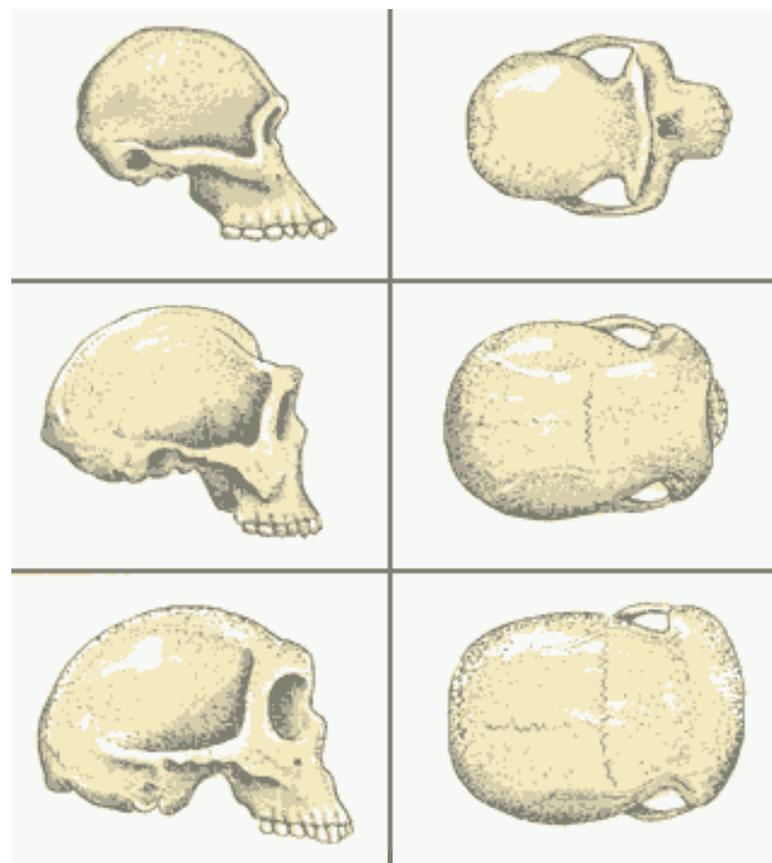
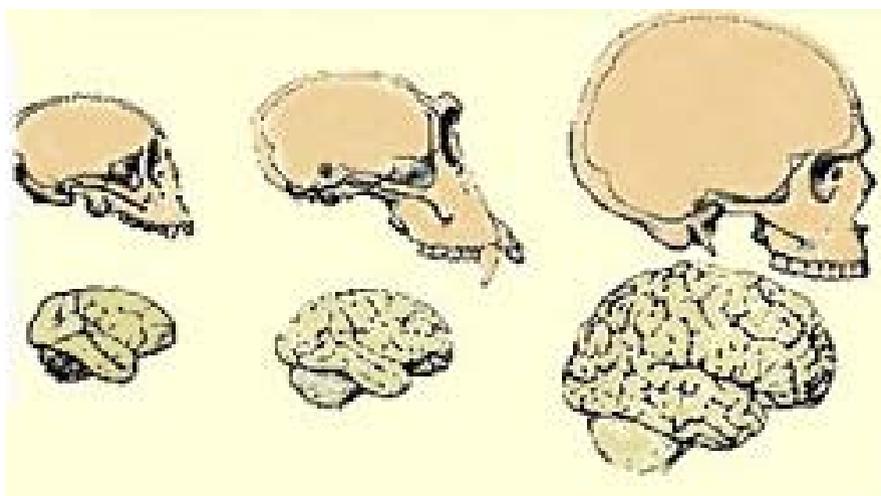
Brain size (in cm^3) plotted against time (Myr) for specimens attributed to Hominidae





Neonatal Infant

6 Year Old Child





Chimpanzee



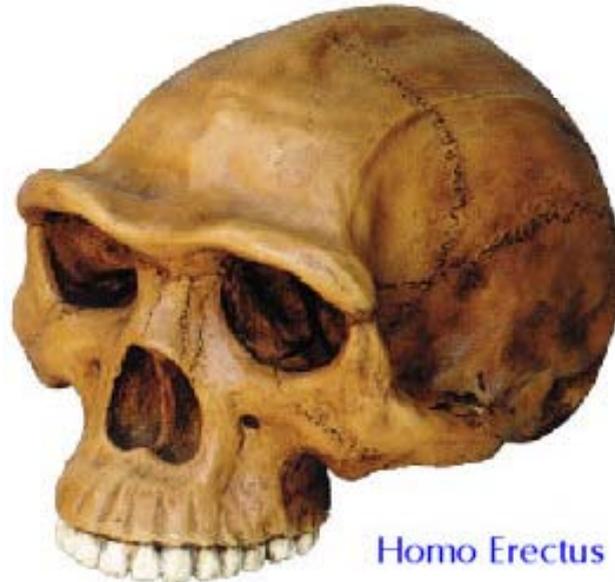
Australopithecus
Afarensis



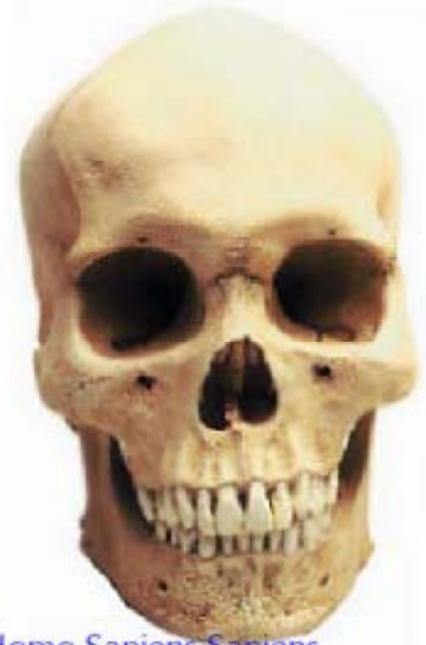
Australopithecus
Africanus



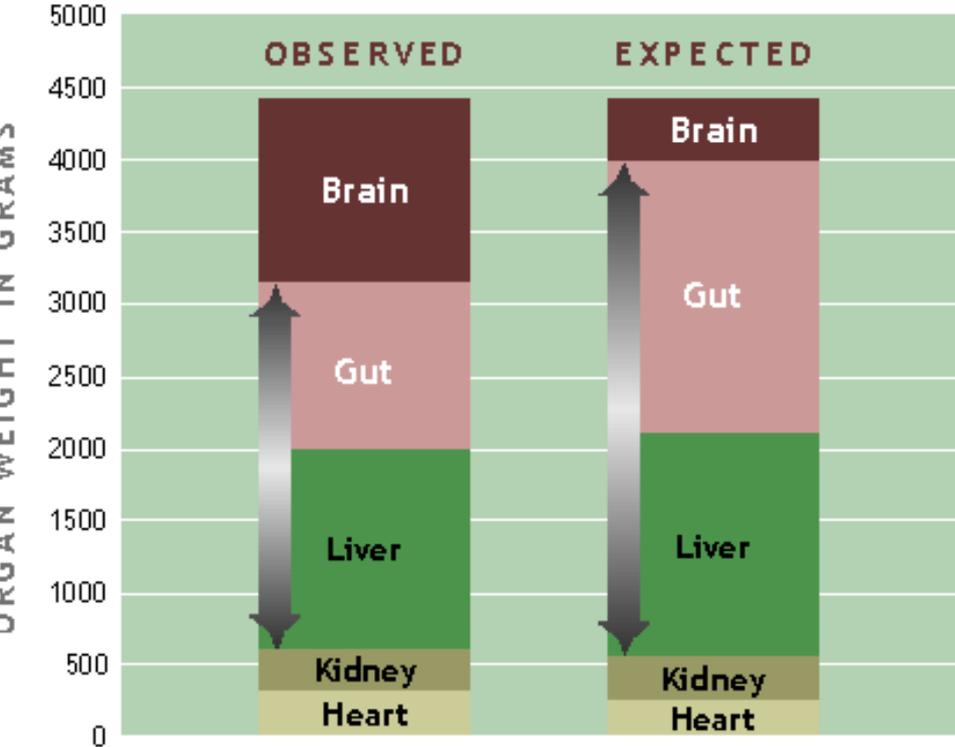
Homo Habilis



Homo Erectus

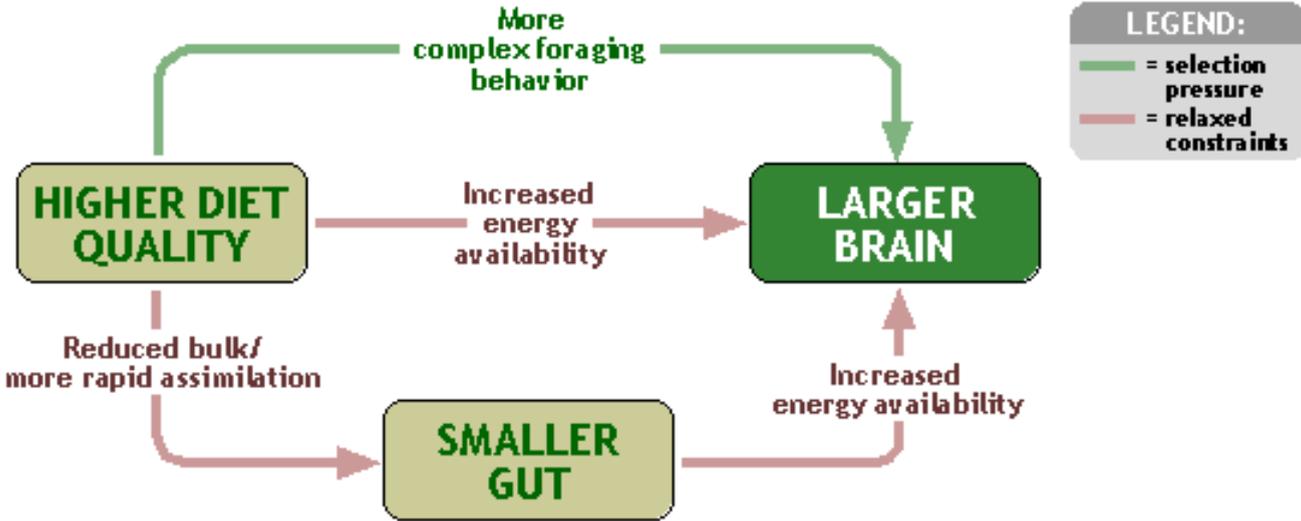


Homo Sapiens Sapiens



Una nuova dieta

Observed and expected organ masses for a "standard" 65-kg human.



bipedismo

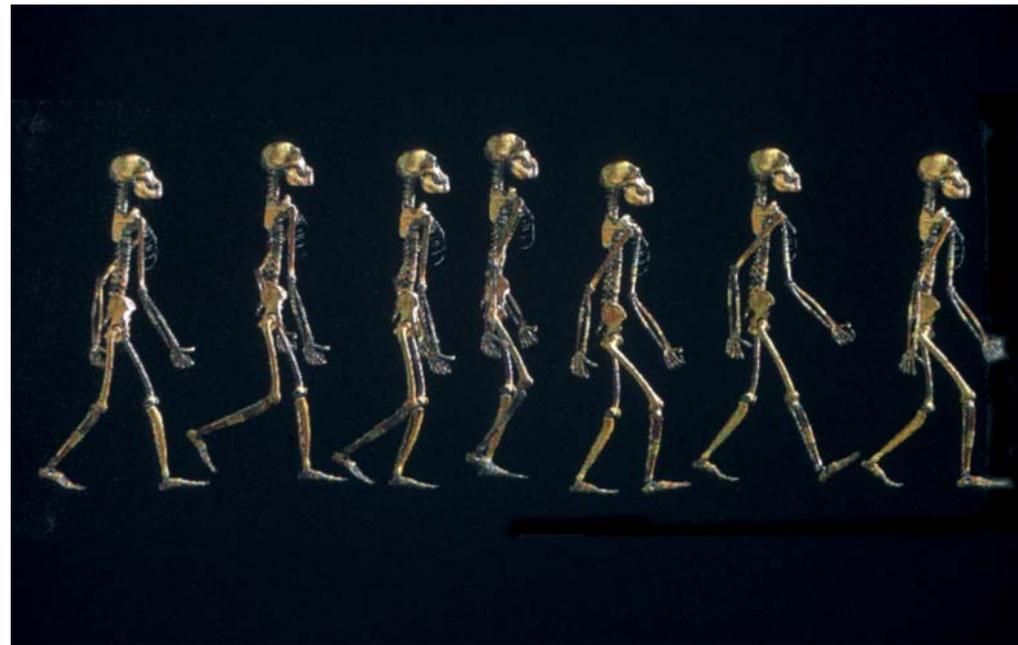
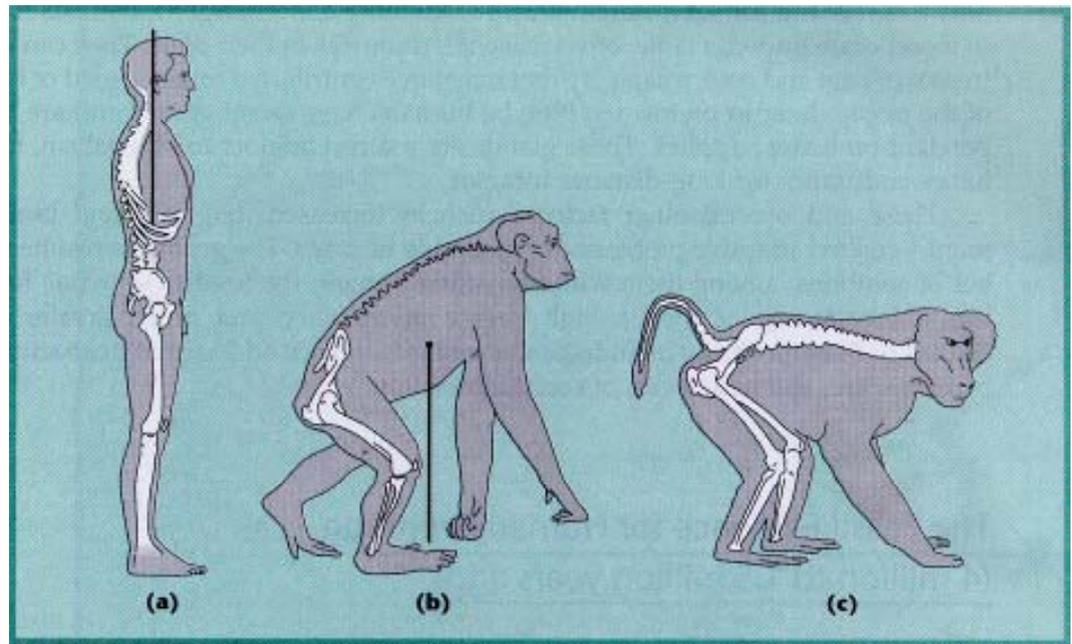
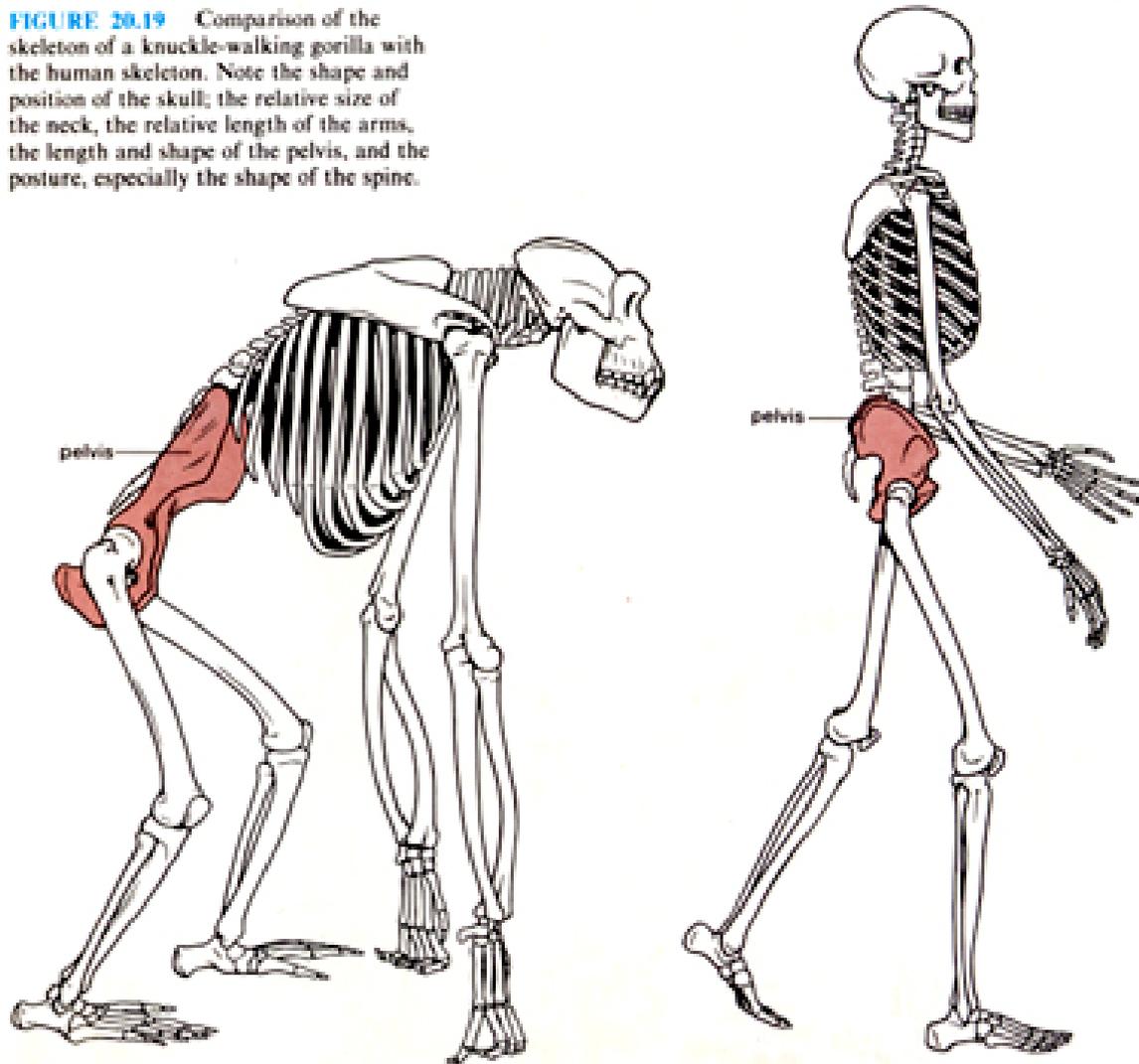
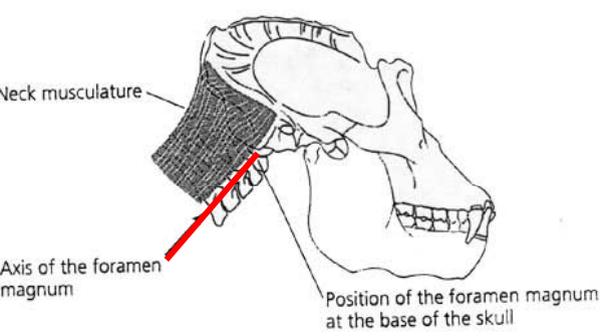
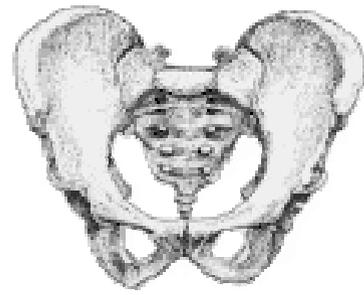


FIGURE 20.19 Comparison of the skeleton of a knuckle-walking gorilla with the human skeleton. Note the shape and position of the skull; the relative size of the neck, the relative length of the arms, the length and shape of the pelvis, and the posture, especially the shape of the spine.

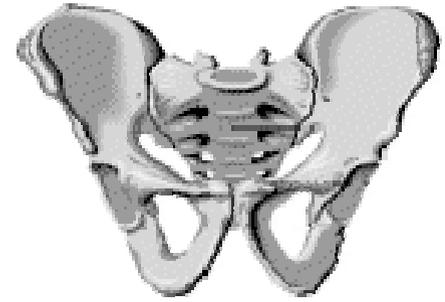




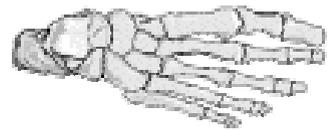
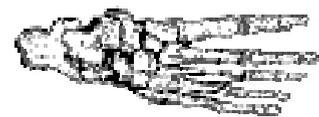
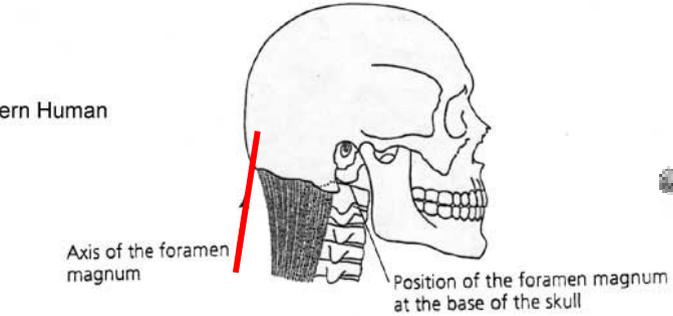
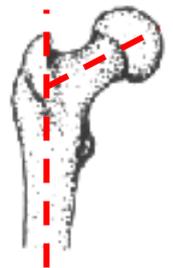
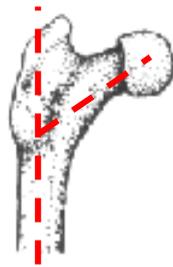
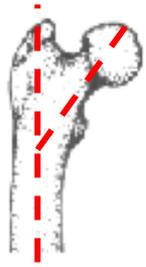
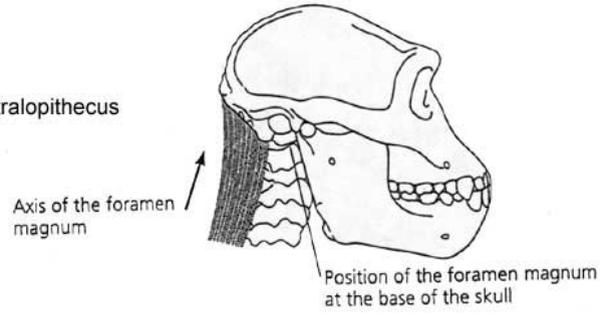
chimpanzee



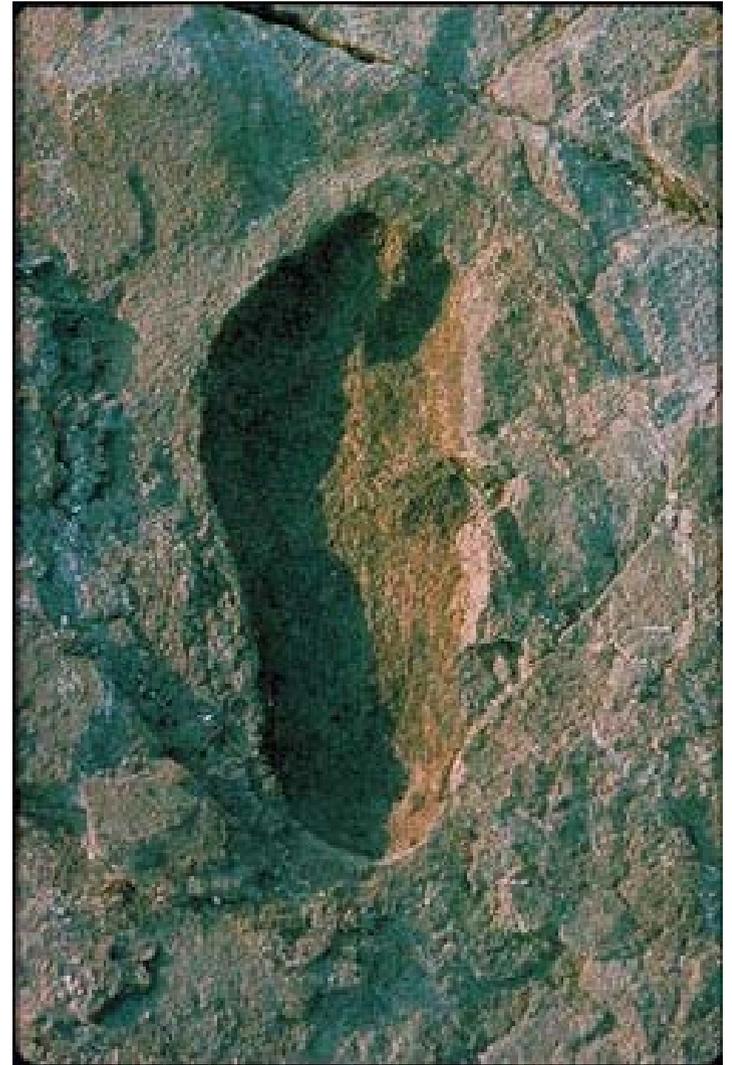
Australopithecus africanus

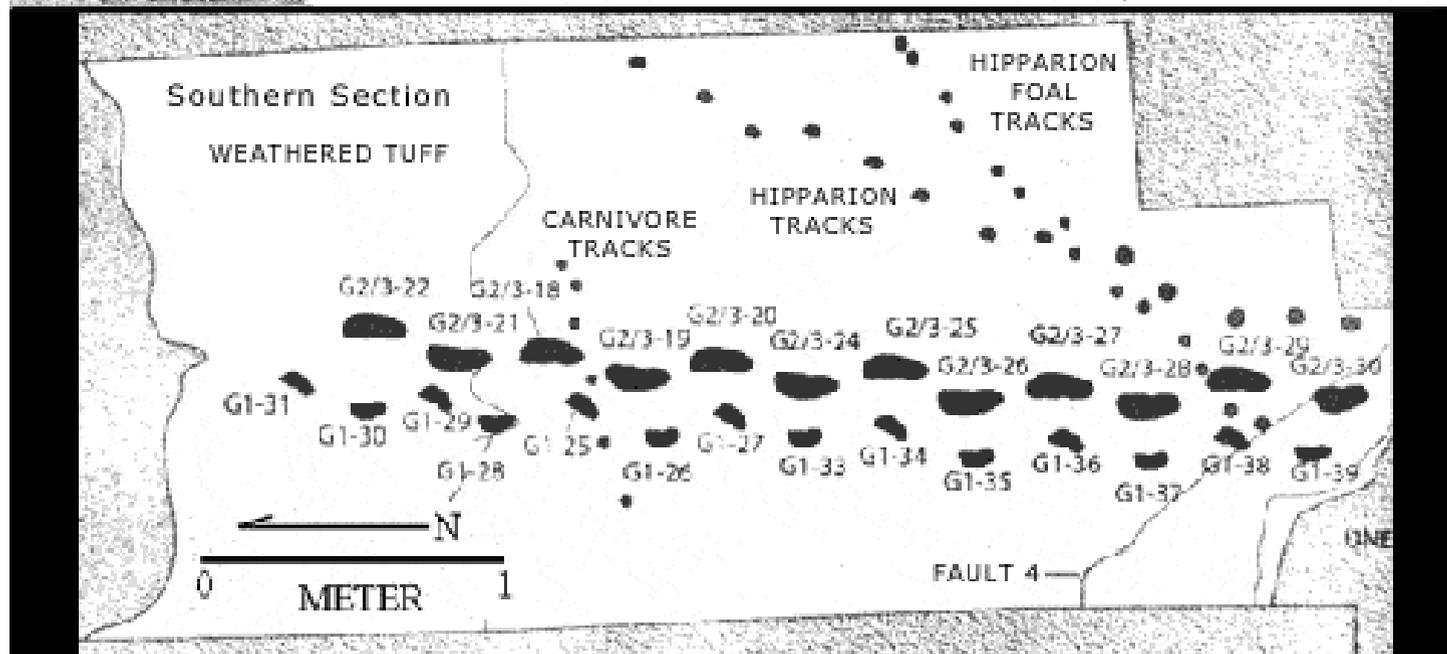
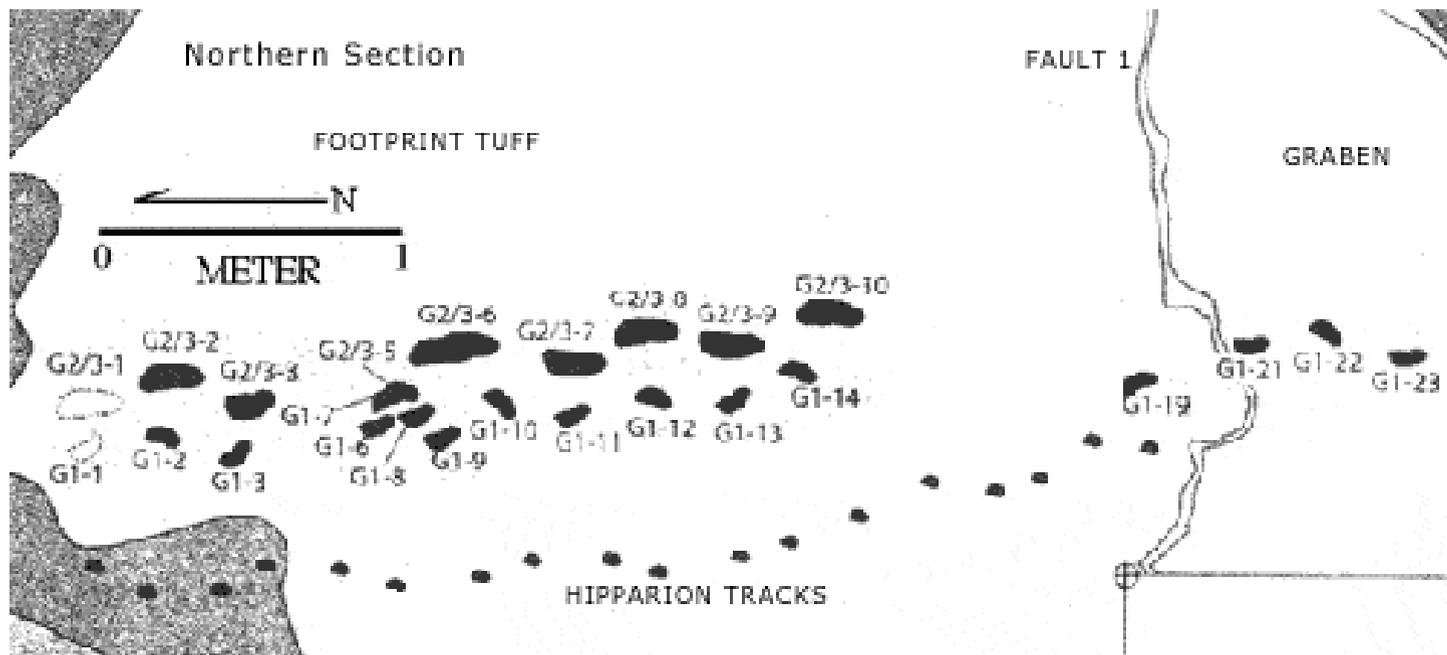


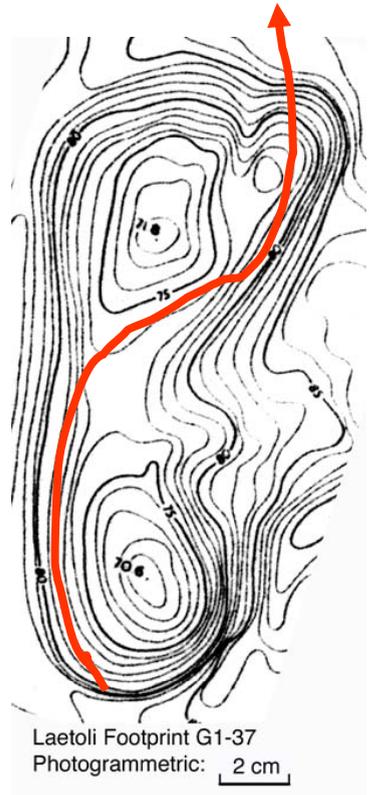
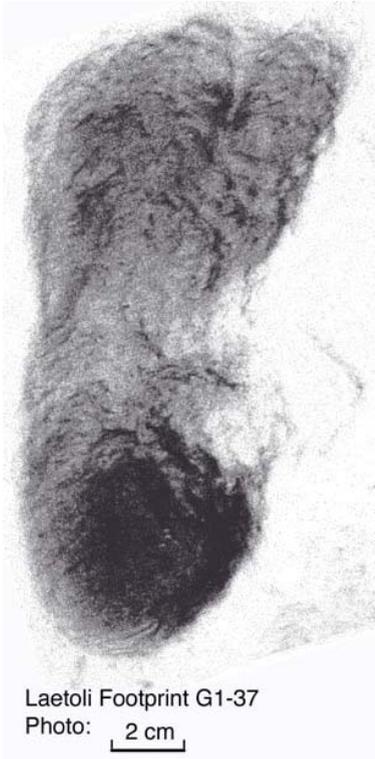
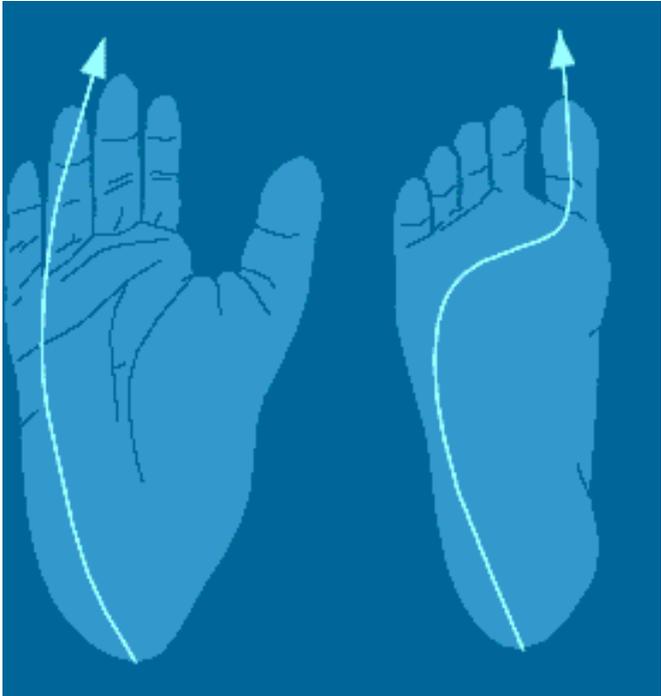
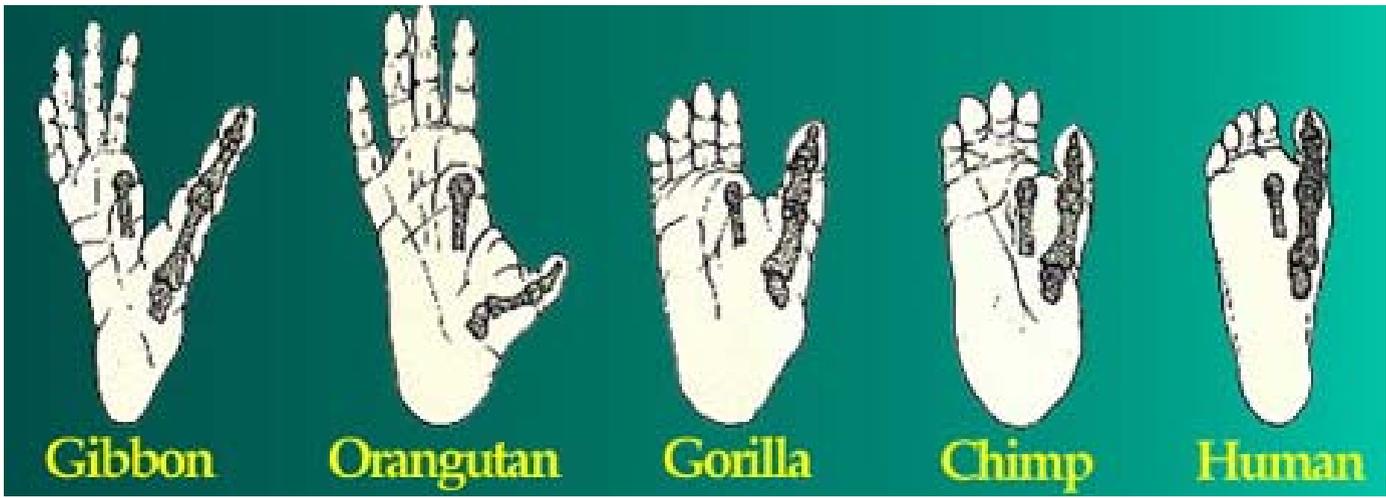
Homo sapiens



Laetoli







Comparison of Primate Hands

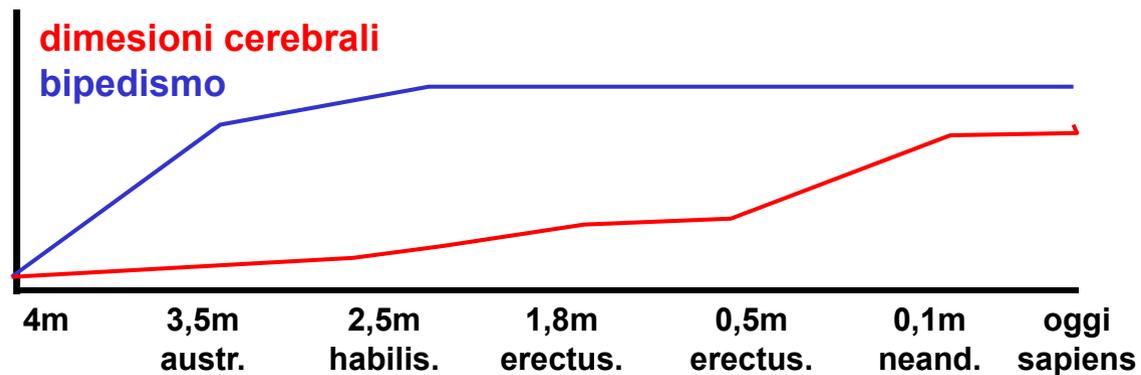


bipedismo

mani libere

controllo motorio

crescita cerebrale



Costruire ed utilizzare strumenti



Caratteristiche distintive dell'uso di strumenti negli ominidi

- Capacità di prevedere le potenzialità dello strumento
- Capacità di progettare lo strumento per uno scopo preciso



0.0-0.01 million years ago

↑ 50K 0.05 (Great Leap Forward)

↑ 250K 0.25

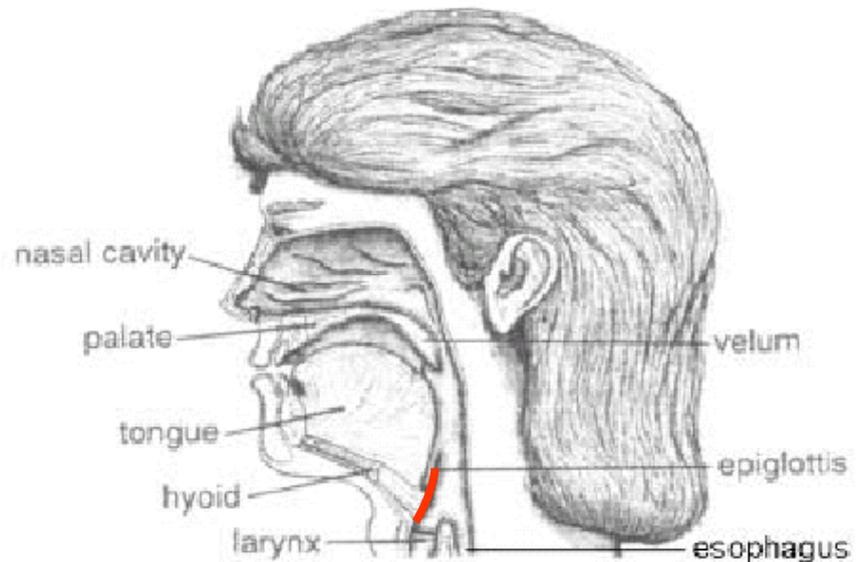
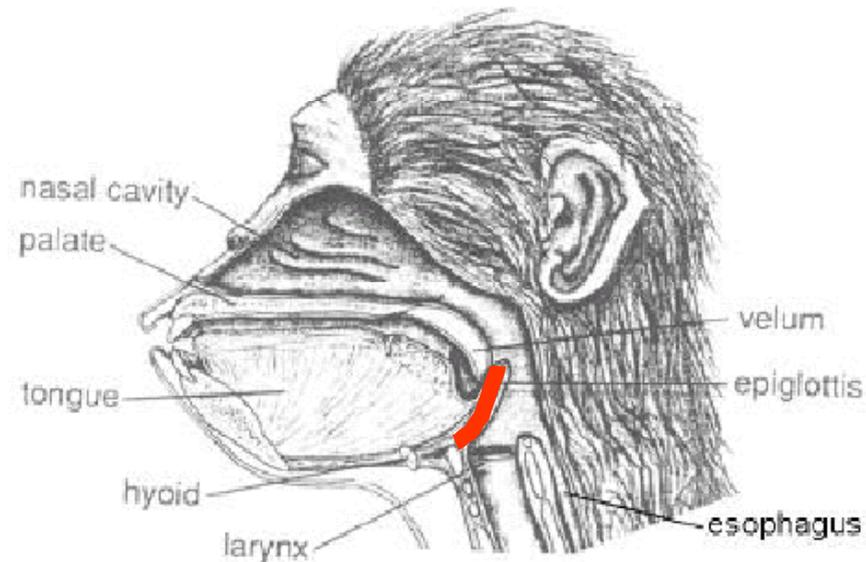
↑ "Out of Africa"

1.7

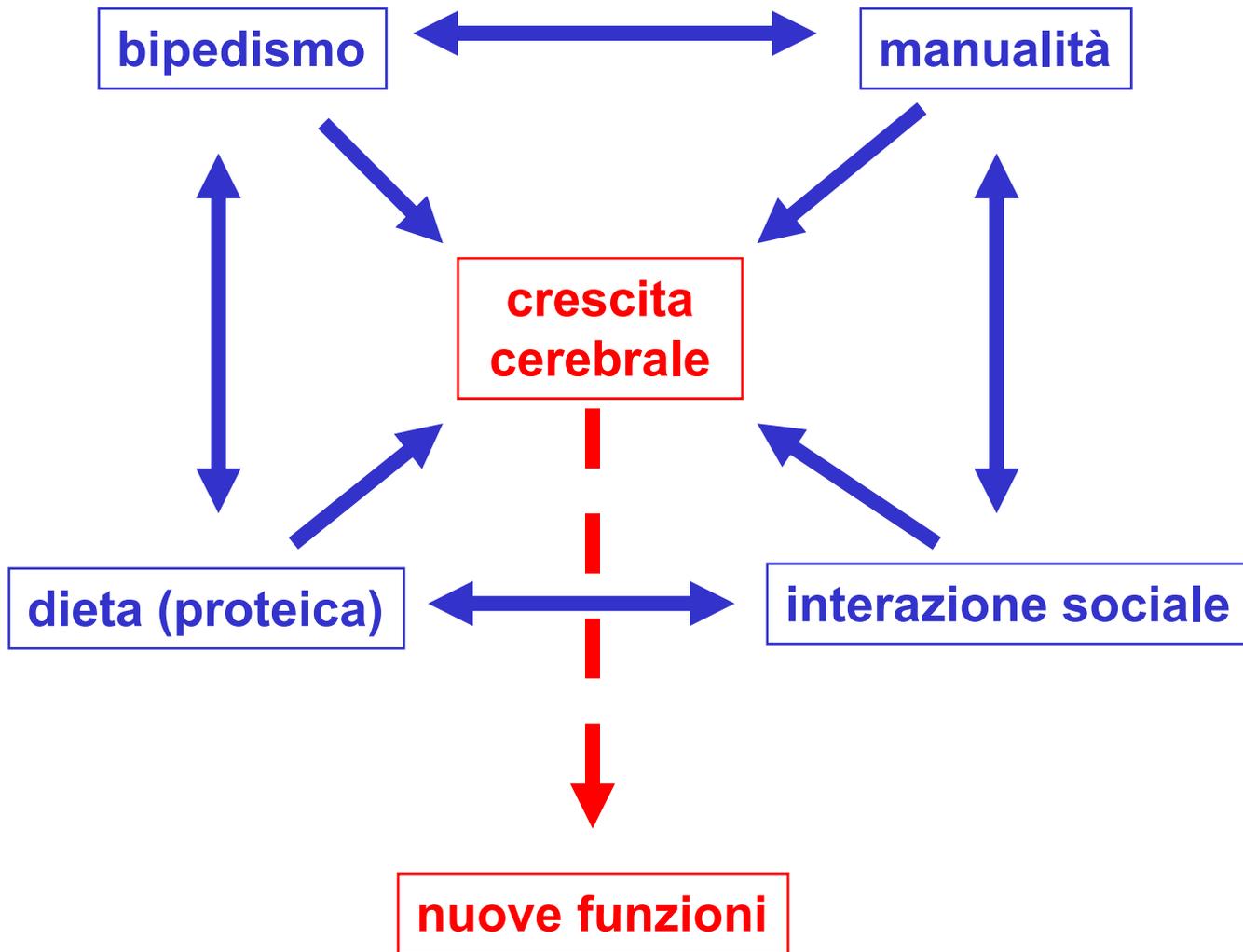
↑ 2.5M 2.5

Upper Paleolithic/ Later Stone Age	Engraving tool	Beveled-base antler point	Ivory needle	Figurine	Bone pendant
Middle Paleolithic/ Middle Stone Age	Levallois flake	Simple, convex sidescraper	Simple, straight sidescraper	Double, straight sidescraper	Mousterian point
Acheulean	Hand ax	Cleaver	Pick	Acute-edged flake	Steep-edged flake
Lower Paleolithic/ Early Stone Age	Acute-edged flake	Steep-edged flake	Flake scraper	Chopper	Polyhedral core
Oldowan	Discoid	Core scraper	Hammerstone	Anvil	

Linguaggio e vocalizzazione



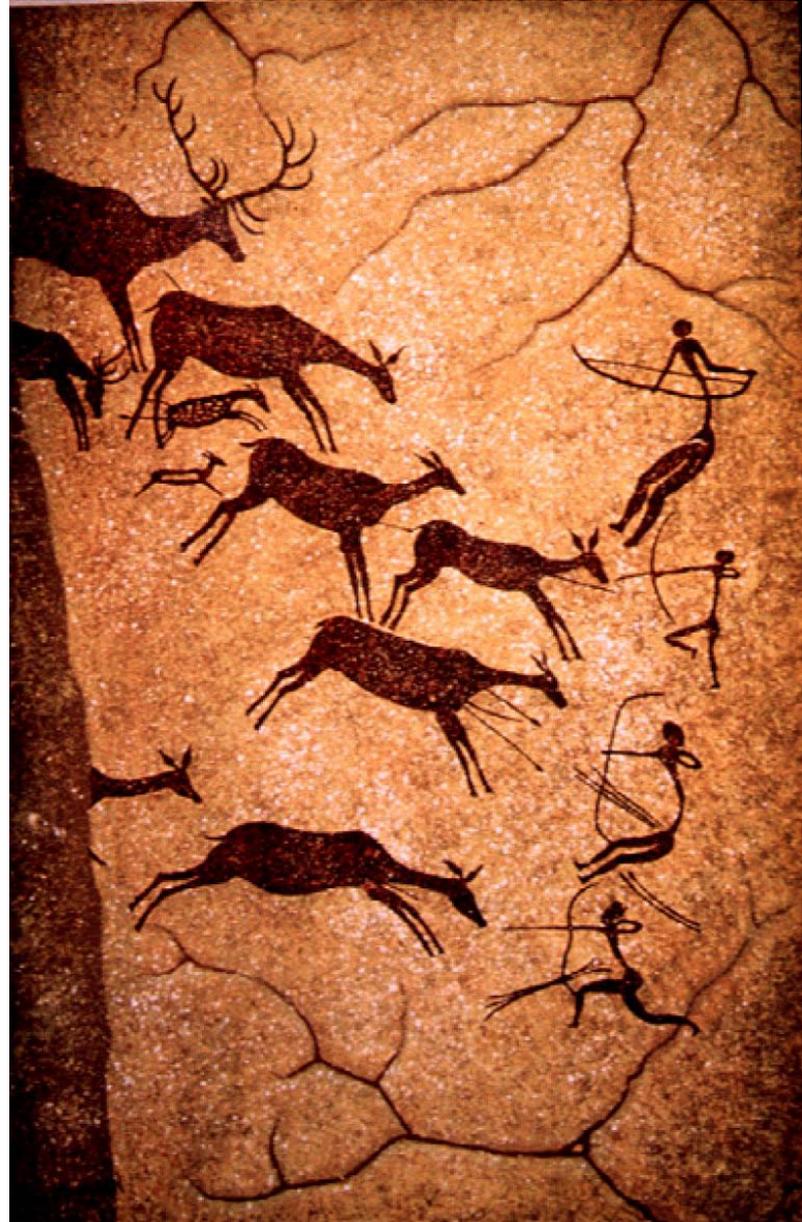
Note that food in the chimpanzee mouth is kept away from the airway (during chewing) by the epiglottis, while in humans, the much lower larynx leaves the back of the mouth (pharynx) open to the airway during chewing, leading to choking if one inhales while food is in the back of the mouth. Another one of nature's little imperfections. Modified from figs. 2-3 and 2-4 in Philip Lieberman's "Uniquely Human", 1991, page 55.

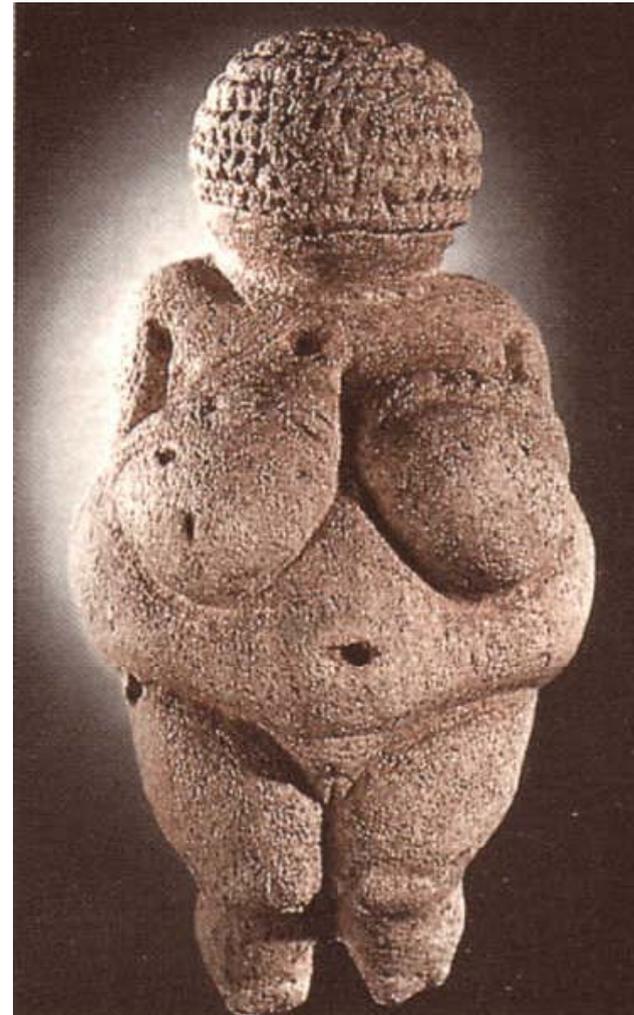


Fine dell'evoluzione biologica, inizio dell'evoluzione culturale

Culto dei morti e autocoscienza

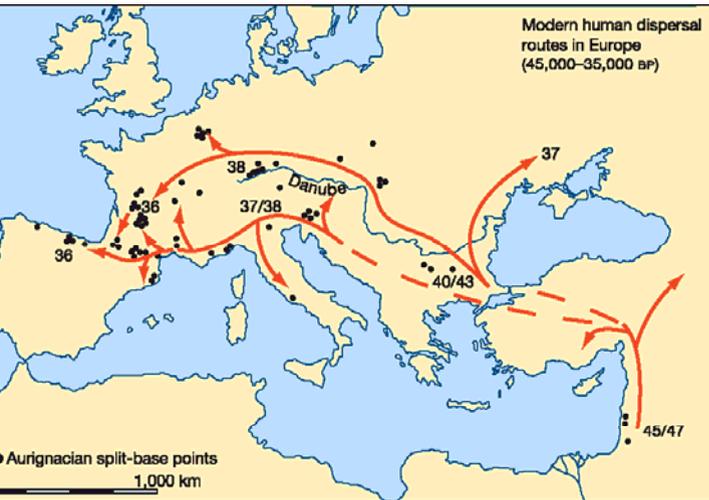






Ice Age Art

(All dates are approximate.)



UPPER PALEOLITHIC EPOCH

IRON AGE 1400 - 1 BC/AD		COMMON ERA BEGINS	
BRONZE AGE 3000 - 1400 BC			
COPPER AGE 5000 - 3000 BC			
NEOLITHIC AGE 9000 - 5000 BC		POLISHED STONE TOOLS	
MESOLITHIC AGE 10,000 - 9000 BC		BEGINNING OF AGRICULTURE	

MAGDALENIAN CULTURE	15,000 - 10,000 BC	CRO-MAGNON PEOPLE	CAVE PAINTINGS
SOLUTREAN CULTURE	20,000 - 15,000 BC		WILLOWPOINTS; BONE TOOLS
AURIGNACEAN CULTURE	390,000 - 20,000 BC		IVORY CARVINGS VENUS STATUETTES

FOURTH GLACIERS - DURATION ABOUT 60,000 YEARS

MOUSTERIAN CULTURE	200,000 - 70,000 BC	NEANDERTHAL PEOPLE	TOOLS WITH RETOUCHE EDGES BURIAL OF THE DEAD
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THIRD GLACIERS - DURATION ABOUT 50,000 YEARS

ACHEULIAN AND CLACTONIAN CULTURES	500,000 - 200,000 BC	ACHEULIANS (FIRST <i>HOMO SAPIENS</i>)	USE OF FIRE; FLINT TOOLS
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SECOND GLACIERS - DURATION ABOUT 60,000 YEARS

CHELLEAN OR ABBEVILLEAN CULTURES	1,000,000 - 500,000 BC	HOMO ERECTUS FIRST TRUE HUMAN	CRUDE STONE TOOLS
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FIRST GLACIERS

LOWER PALEOLITHIC EPOCH