Bio1B Evolution 12

Last lecture: Fossil record (cont.)

Mass extinctions - the "K/T" boundary - asteriod hypothesis; dinosaue extinctions, radiation of mammals

Transitional forms - tetrapods, birds: "exaptation"

Evolution of developmental programs - "deep homology"; eg. vertebrate limbs, animal eyes

Today

Evolutionary origins of *Homo sapiens*: fossils & molecular evidence

Recent evolution of humans - eg lactose tolerance in adults

Evolutionary medicine: basic concepts and examples

Pathogen evolution - eg. HIV evolution within single hosts

Metabolic diseases: "thrifty gene hypothesis" & obesity, type 2 diabetes

Further courses in Evolution at UC Berkeley

Evolution of hominins: fossil evidence I

- Hominins split from common ancestor with chimps about 7Myr; African origins, diversity expands 4-2Myr
- Key features: bipedalism, smaller canines (large brain later)
- *A. ramidus* - neither chimp nor human - see display in VLSB
- "Australopiths" probably paraphyletic with Homo

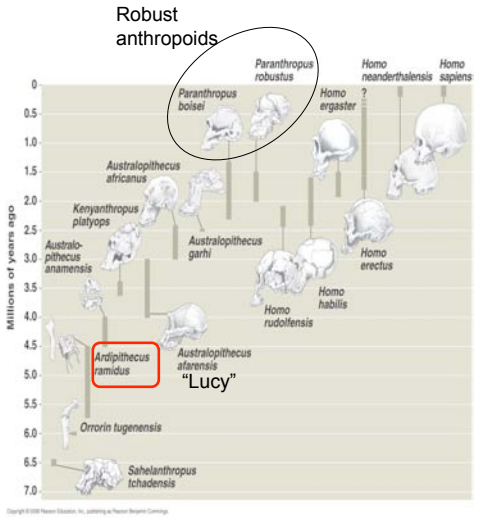


Fig. 34.40

Evolution of hominins: fossil evidence II

- Homo - key features: increasing brain size, lower sex dimorphism, more terrestrial
- African origins; *H. erectus* -> europe >1.8Myr -> Indonesia ("Java man"). Extinct 200 Kya?
- *H. floriensis* - >1M? - 12Kya. Related to H. erectus?
- Neanderthals - Europe and near east, 200-24Kya

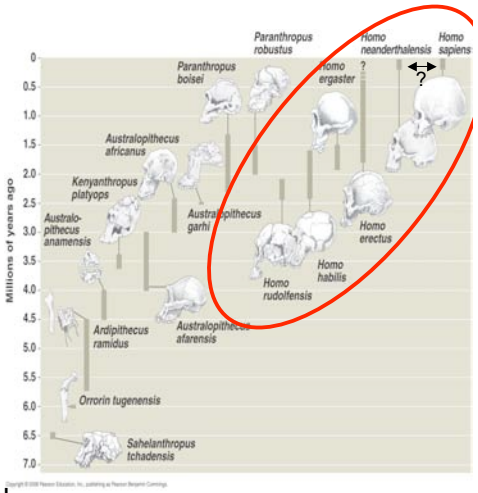
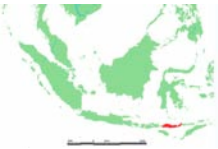


Fig. 34.40

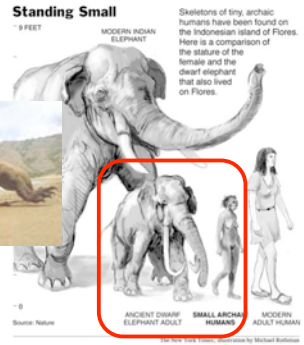
Evolution of hominins: fossil evidence III



H. floriensis Microcephalic *H. sapiens*

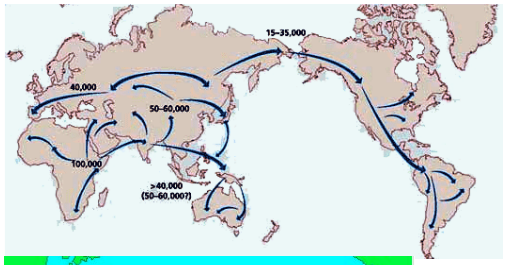
H. floriensis

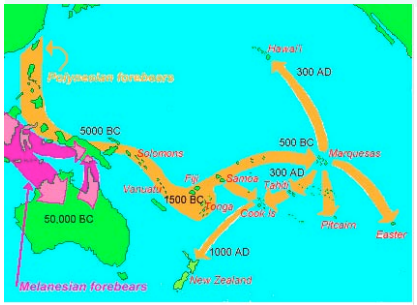
- Possibly persistent relative of H. erectus [or malformed H. sapiens?]
- Exemplifies humans evolve as other species: dwarfing of large mammals on islands - eg. Stegodon "pygmy elephants & huge lizards! (Varanus)
- Putative tools >1Myr, fossils to 12Kya - overlapping H. sapiens



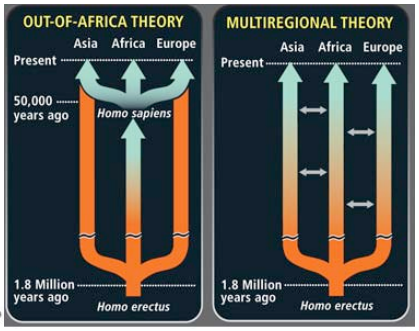
Migration of *H. sapiens*

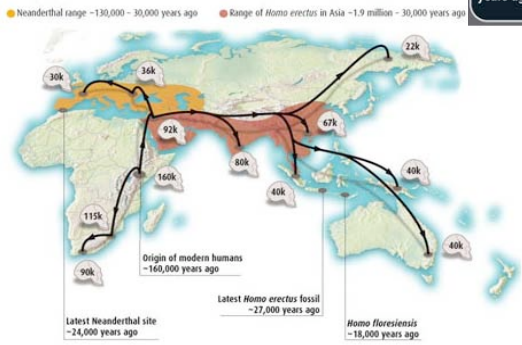
- Out of Africa - about 100Kya
- Rapid spread across Sth Asia to Australia & central Asia
- One or 2 colonizations across Bering bridge during last ice age -> rapid spread to Sth America
- Polynesian migrations across Pacific are recent: 1500 BC to 1000 AD (New Zealand)





Modern humans & related species - hybridization or replacement?

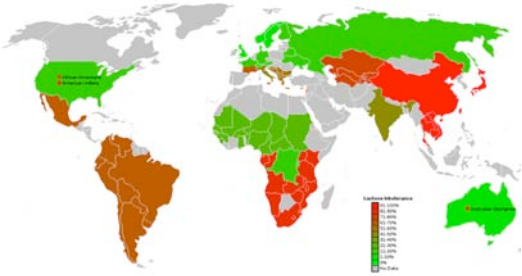




Genetic evidence largely supports single origin & "out-of- Africa" over independent origins from different populations of *H. erectus* (multi-regional).

But did modern humans hybridize with, or simply replace neanderthals?

Recent evolution in humans - lactose tolerance in adults



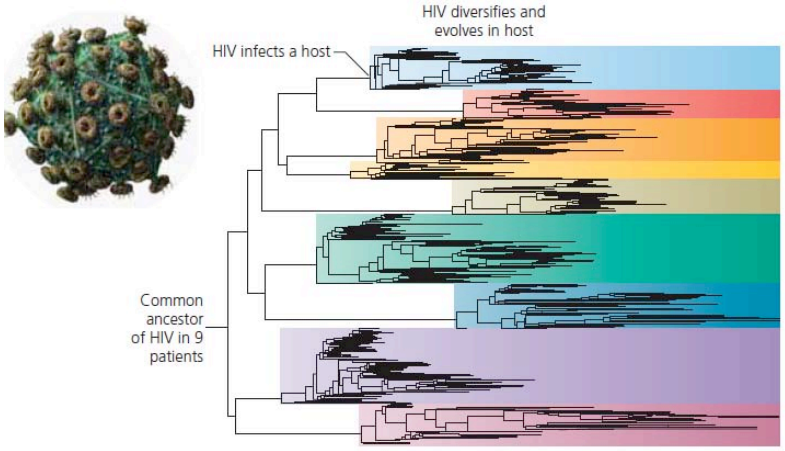
- Tolerance of lactose <u>in adults</u> is a recently evolved trait in humans
- Molecular analyses show independent origins from different mutations in lactase gene in Africa and Nth Europe
- The mutations are absent from fossil neolithic farmers 6-5Kya
- Lactose intolerance is the norm, not a disease!

Principles of Evolutionary Medicine

(see Zimmer pdf; also new course in IB - Tom Carlson)

- Understanding evolutionary basis of disease risk can improve diagnosis and prevention
- Variation in human phenotypes results from genetic variation and environmental influences on development
- Selection operates to maximize (inclusive) fitness, not health and longevity. This can result in <u>trade-offs</u>

Rapid evolution of pathogens: HIV (an RNA virus) within hosts



From Zimmer 2009

Evolutionary mismatches & constraints

see Zimmer pdf

- "Thrifty genes hypothesis"
  - Native American and others selected for efficient metabolism because of history of famine => with "obesogenic" food types very prone to obesity + type II diabetes
- Rapid life history evolution, aging and late-onset diseases
  - Tradeoff between selection for genes important pre-reproduction (growth) and post-reproduction (repair)
- Hygiene hypothesis - reduced exposure to pathogens in children => increase in autoimmune disease (athsma etc)?
- Evolutionary constraints: appendix, detached retina, small birth canal cf, brain size, etc.…