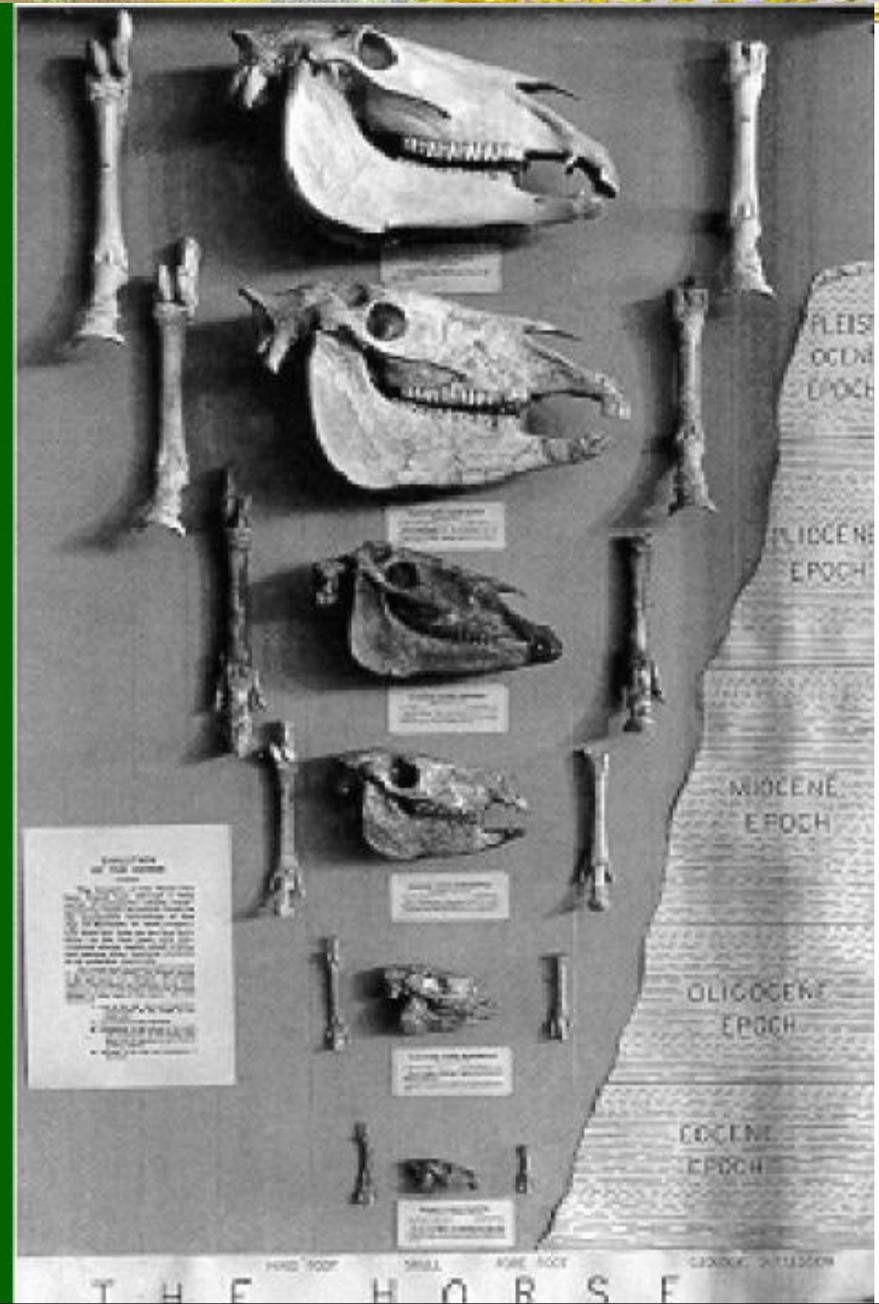


Bukti-Bukti Evolusi

>Genetika dan Biologi Molekuler



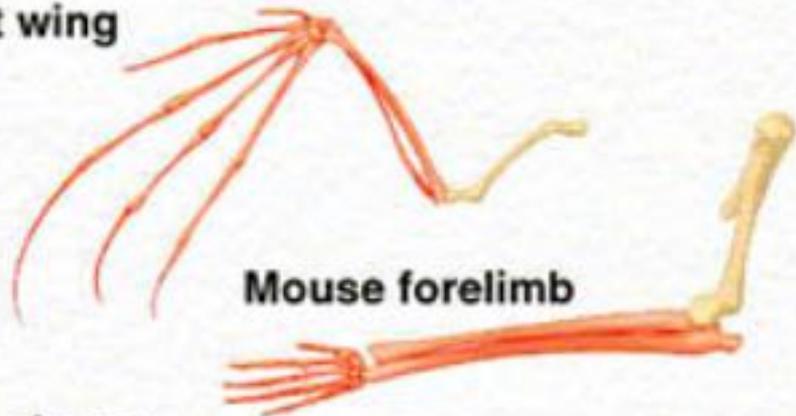
American Museum of Natural History. An exhibit from old mammal halls showing simplistic version of the evolution of the horse. Fossils are arranged chronologically, from oldest to youngest fossil. From Dingus (1996).



Homology and analogy

Homology

Bat wing



Human arm



Mouse forelimb

Analogy

Bat wing



Butterfly wing



Bird wing



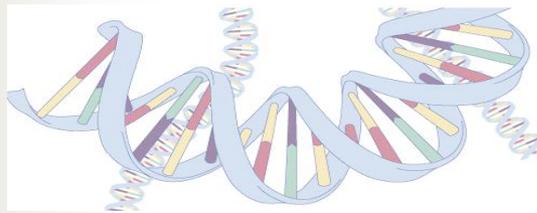


Figure 3-10

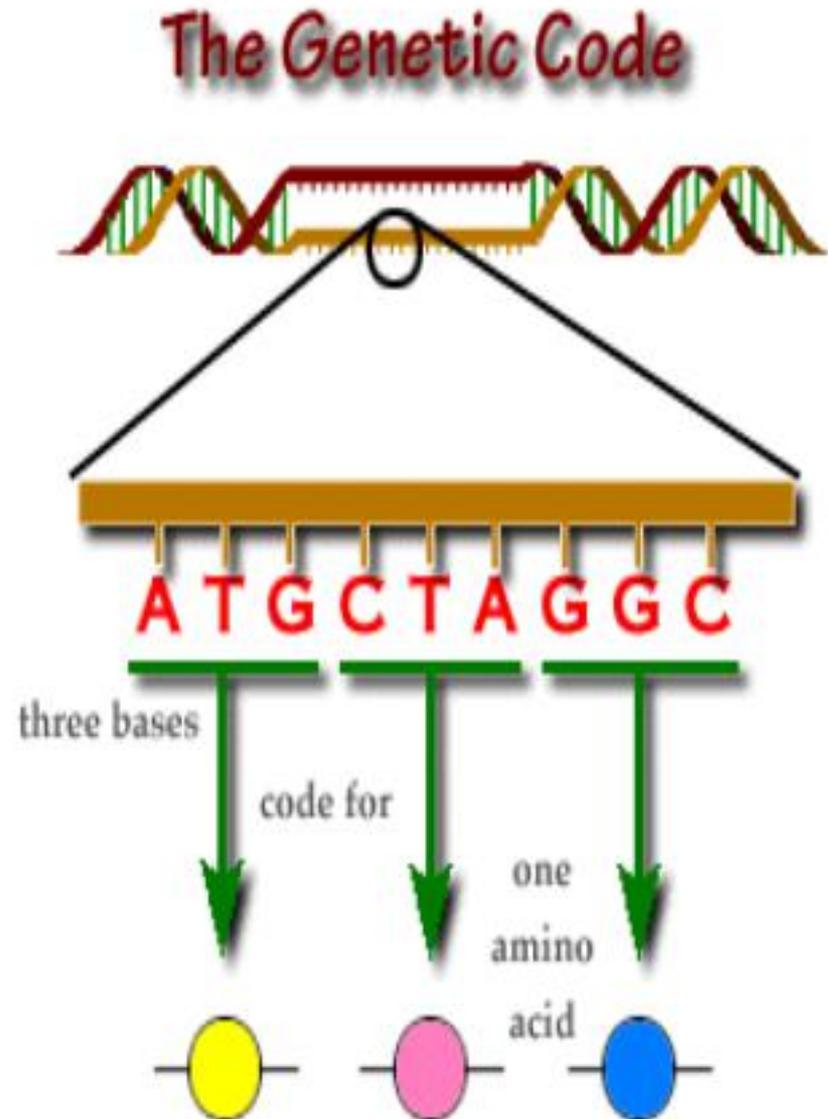
A series of embryos of different vertebrates at comparable stages of development. The earlier the stage of development, the more strikingly similar are the different groups. Note that each of the embryos begins with a similar number of gill arches (pouches below the head) and a similar vertebral column. In later stages of development, these and other structures are modified to yield the various, different

Bukti Biologi Molekuler

- DNA used to translate nucleotide sequences into amino acid is essentially the same in all organisms



- Proteins in all organisms are composed of the same set of 20 amino acids
- Powerful argument in favor of the common descent of the most diverse organisms.



Universal Code

		Second Letter					
		T	C	A	G		
First Letter	T	TTT } Phe TTC } TTA } Leu TTG }	TCT } TCC } Ser TCA } TCG }	TAT } Tyr TAC } TAA } Stop TAG } Stop	TGT } Cys TGC } TGA } Stop TGG } Trp	T	C
	C	CTT } CTC } Leu CTA } CTG }	CCT } CCC } Pro CCA } CCG }	CAT } His CAC } CAA } Gln CAG }	CGT } CGC } Arg CGA } CGG }	T	C
	A	ATT } Ile ATC } ATA } Met ATG }	ACT } ACC } Thr ACA } ACG }	AAT } Asn AAC } AAA } Lys AAG }	AGT } Ser AGC } AGA } Arg AGG }	T	C
	G	GTT } GTC } Val GTA } GTG }	GCT } GCC } Ala GCA } GCG }	GAT } Asp GAC } GAA } Glu GAG }	GGT } GGC } Gly GGA } GGG }	T	C
						A	G
						Third Letter	



Biochemical Compound Ex

- DNA
- Cyt C
- 20 amino acids
- Some enzymes

Molecular/Biochemical Evidence

■ Cytochrome c

- An ancient protein common to all aerobic (oxygen breathing) organisms
- Amino acid sequence to make cytochrome c differs increasingly the more distantly related two organisms are (very similar amino acid sequence = closely related)
- The cytochrome c of humans and chimpanzees is identical



Evolutionary Prediction Supported

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Amino acids reveal evolution

Cytochrome c Evolution

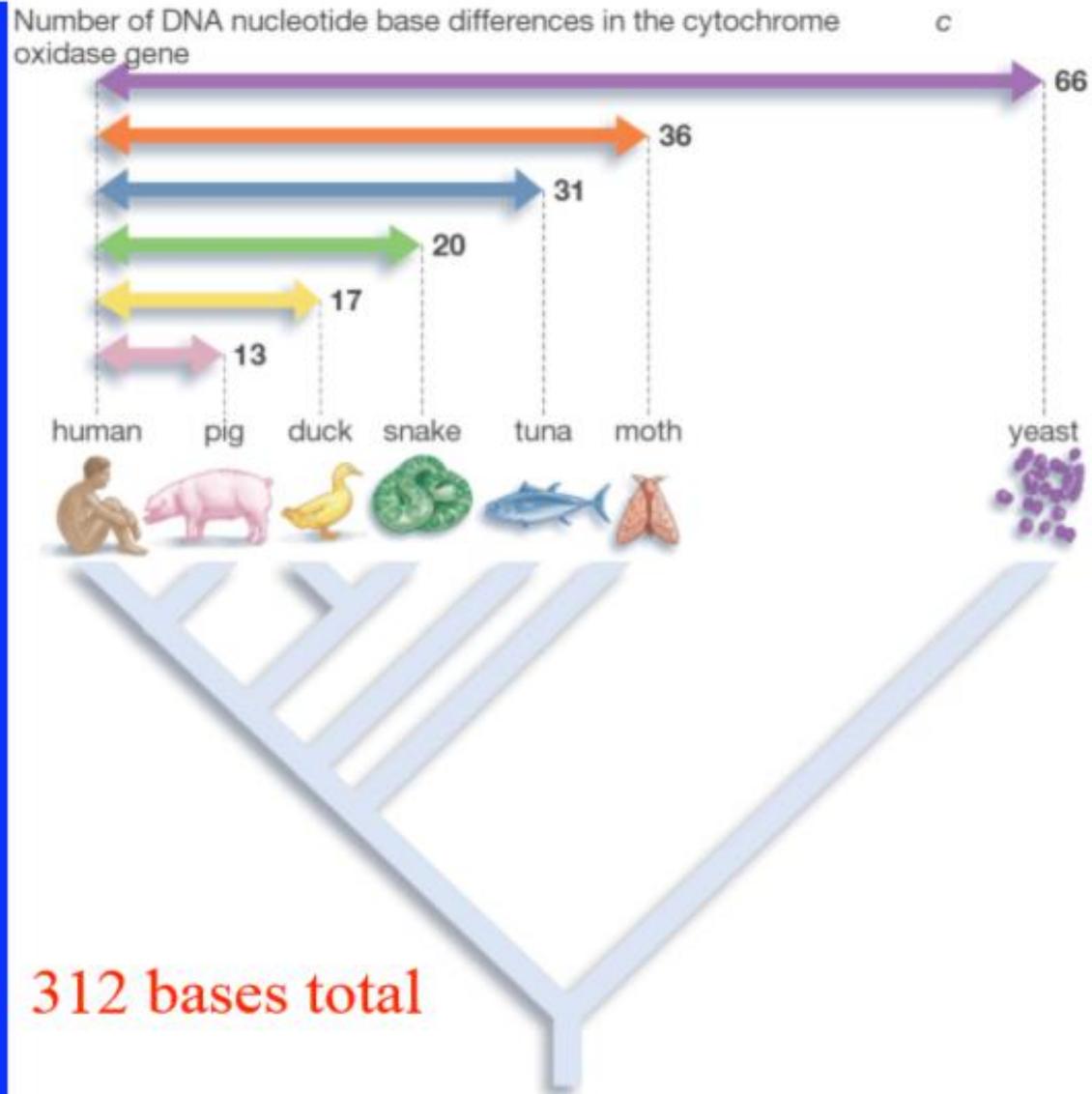
	Organism	Number of amino acid differences from humans
	Chimpanzee	0
	Rhesus monkey	1
	Rabbit	9
	Cow	10
	Pigeon	12
	Bullfrog	20
	Fruit fly	24
	Wheat germ	37
	Yeast	42

A

Conservation at the Molecular Level

Why else should different organisms possess related genes?

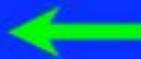
Why does the degree of relationship of genes match their degree of relationship established by other methods?



Testing the Evolutionary Hypothesis of Common Ancestry

Chromosome numbers in the great apes:

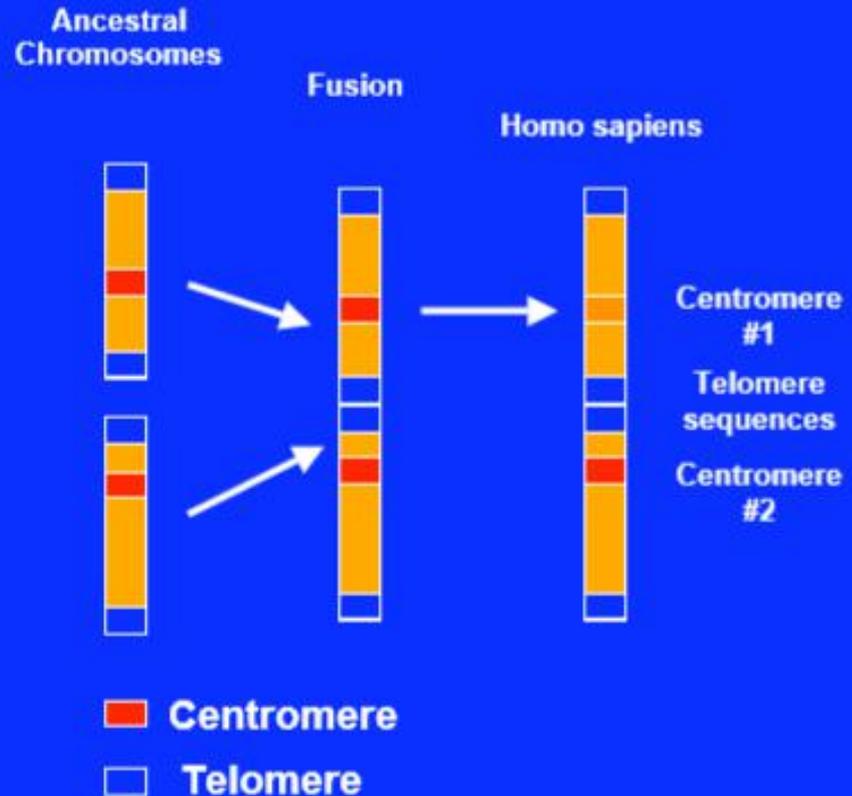
human (Homo)	46
chimpanzee (Pan)	48
gorilla (Gorilla)	48
orangutan (Pongo)	48



Testable prediction: If these organisms share common ancestry, the human genome must contain a fused chromosome.

Chromosome numbers in the great apes (Hominidae):

human (Homo)	46
chimpanzee (Pan)	48
gorilla (Gorilla)	48
orangutan (Pongo)	48



Testable prediction: The marks of that fusion must appear in one of the human chromosomes.



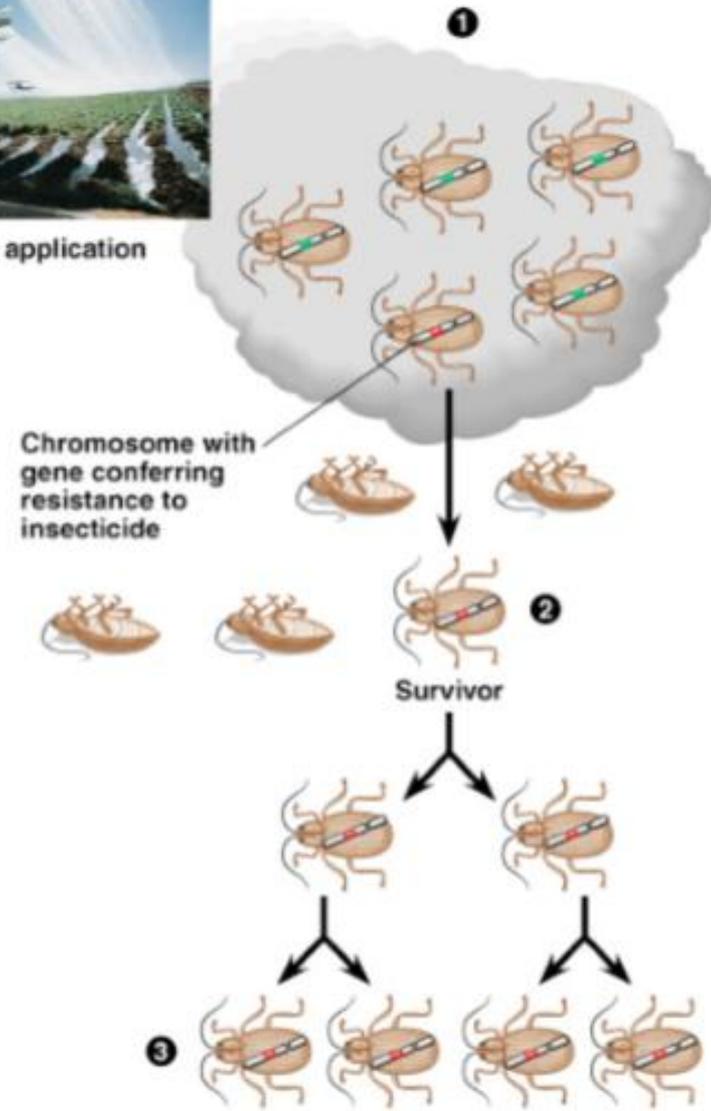
Perspective

- Humans, chimps are different
E.g., we're much smarter
- No reason to be ashamed of common ancestry with chimps!
Remember, current apes aren't our ancestors; they are more like cousins
- Rapid changes (brain size) can occur with small changes in genome; complicated

Evolution of pesticide resistance



Insecticide application



Evolution and Genetic Diversity

- 1800s: “lumper” potatoes (clones) grown for Irish
- 1840s: potato blight hits, all potatoes susceptible
- 1 in 8 Irish died during this period
- Genetic diversity is key to surviving diseases

