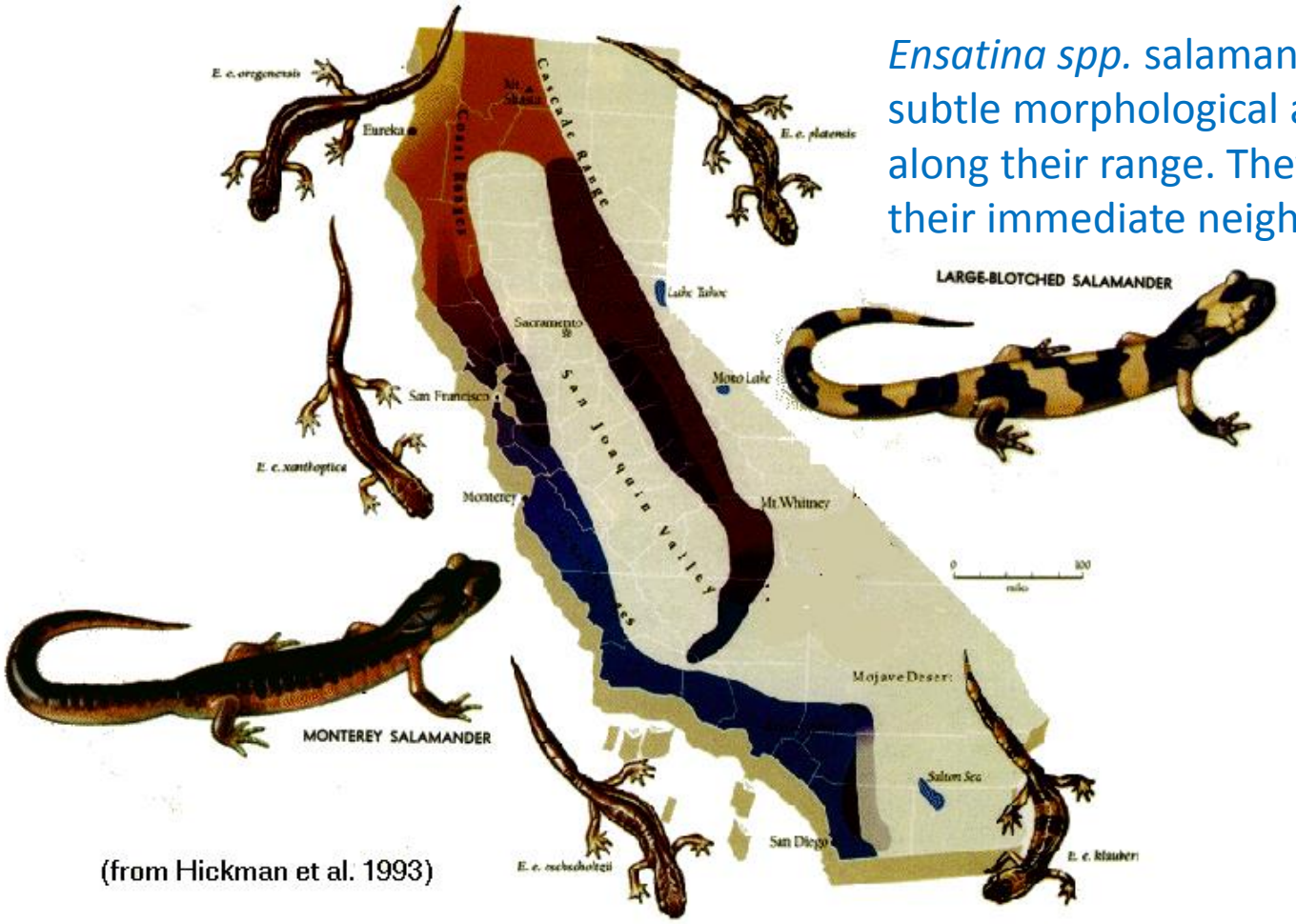
What is a species?

An early idea was the Morphological Species Concept which basically means that if you look different then you are a different species.

Any problems with this?



(from Hickman et al. 1993)

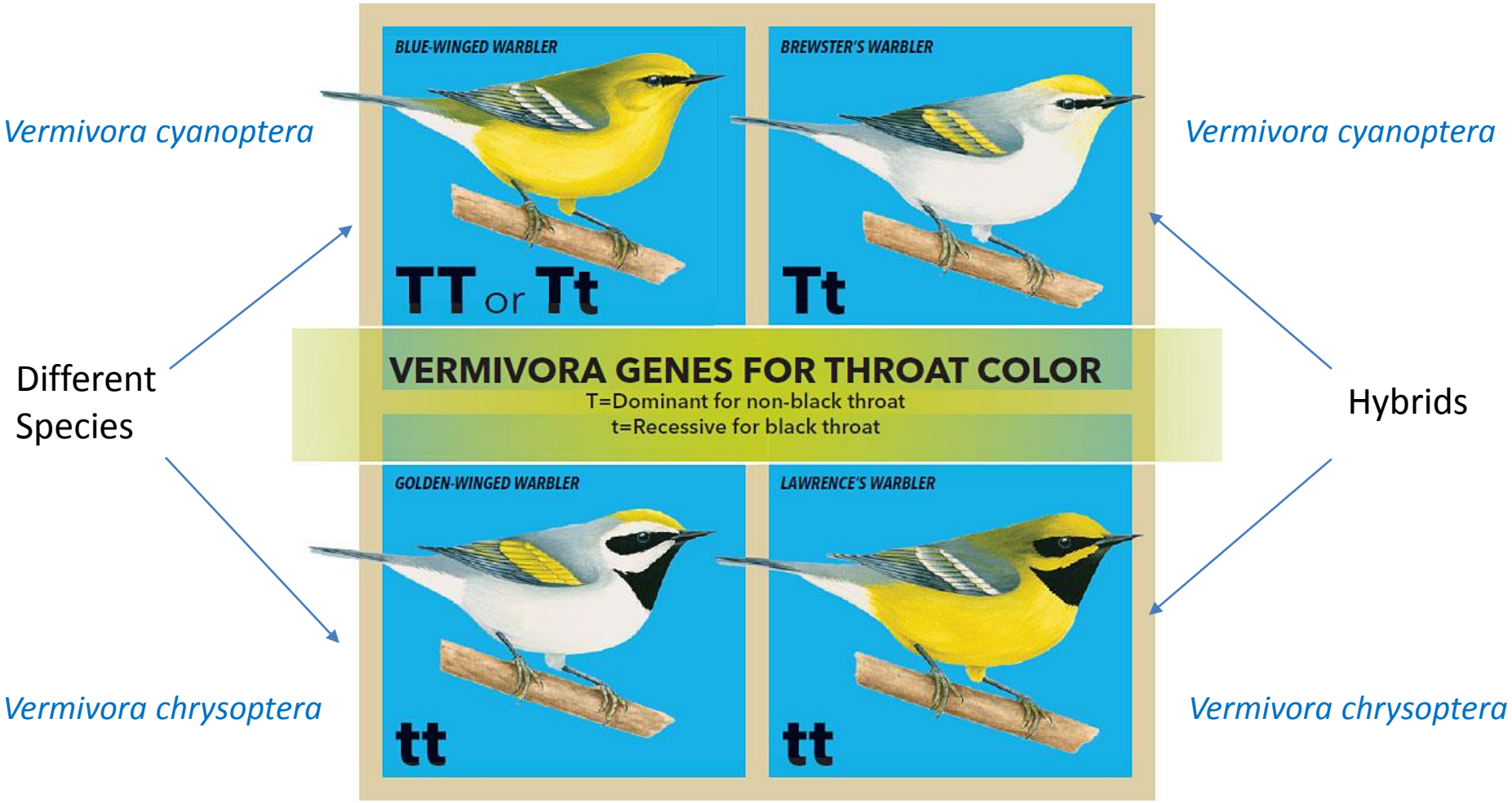
Ensatina spp. salamanders in California exhibit subtle morphological and genetic differences along their range. They all interbreed with their immediate neighbors.

Biological Species Concept

Defines species as a group of interbreeding organisms that can produce fertile offspring and cannot interbreed with other species.

Any problems with this?

+



Illustrations by Liz Clayton Fuller

Research from the Cornell Lab of Ornithology shows that the genetic differences between Golden-winged and Blue-winged Warblers are found in just six regions and in only .03 percent of their entire genomes. In other words…they are 99.7% the same!

One of those regions contains genes that control throat coloration.

Evolutionary Species Concept

"an entity composed of organisms which maintains its identity from other such entities through time and space, and has its own independent evolutionary fate and history."

--Mayden, 1997.

Table 19.1 Species concepts and standardized abbreviations

1. Agamospecies (ASC)
2. Biological (BSC)
3. Cohesion (CSC)
4. Cladistic (CISC)
5. Composite (CpSC)
6. Ecological (EcSC)
7. Evolutionary Significant Unit (ESU)
8. Evolutionary (ESC)
9. Genealogical Concordance (GCC)
10. Genetic (GSC)
11. Genotypic Cluster Definition (GCD)
12. Hennigian (HSC)
13. Internodal (ISC)
14. Morphological (MSC)
15. Non-dimensional (NDSC)
16. Phenetic (PhSC)
17. Phylogenetic (PSC)
    1. Diagnosable Version (PSC_1)
    2. Monophyly Version (PSC_2)
    3. Diagnosable and Monophyly Version (PSC_3)
18. Polythetic (PtSC)
19. Recognition (RSC)
20. Reproductive Competition (RCC)
21. Successional (SSC)
22. Taxonomic (TSC)

-- Mayden, 1997

How do species form?

Evolution

is change in a species over time.

However, it is not a single organism that changes but the genetic material of the species that changes over time.

What is the process by which evolution occurs?

Natural Selection

Natural selection is the process by which organisms that are best suited to their environment survive and pass their **genetic traits** on to their offspring.

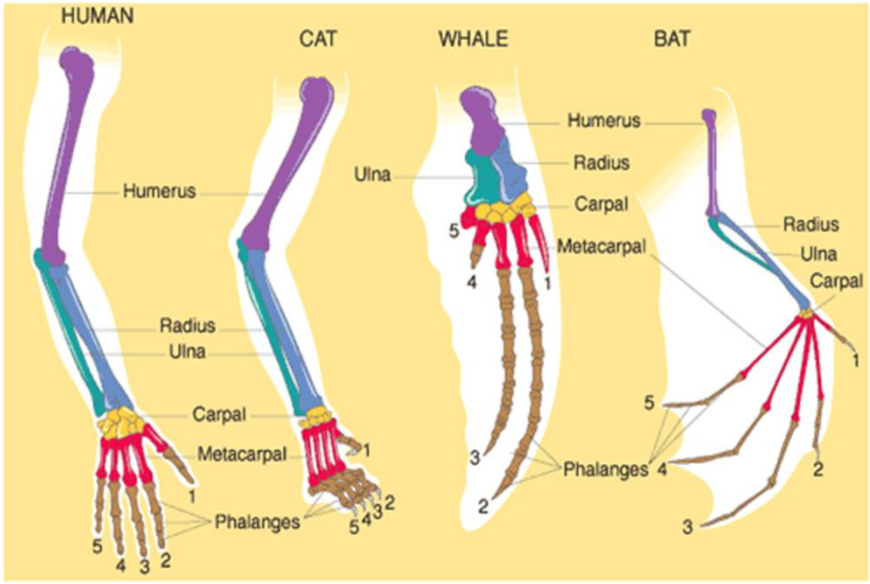
The Making of the Fittest: Natural Selection and Adaptation

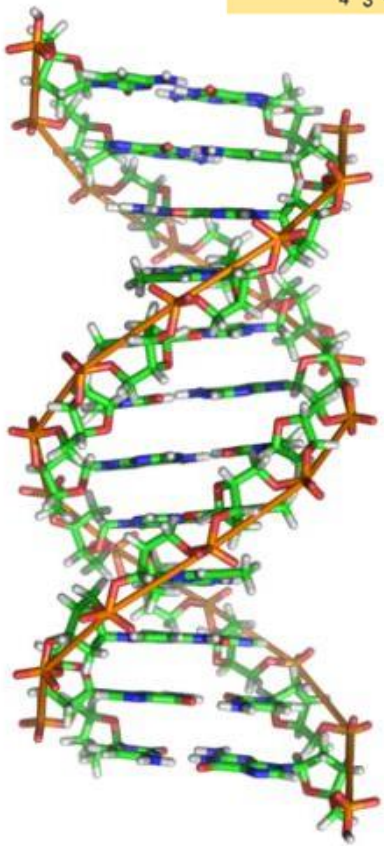
http://www.hhmi.org/biointeractive/pocket-mouse-film-quiz

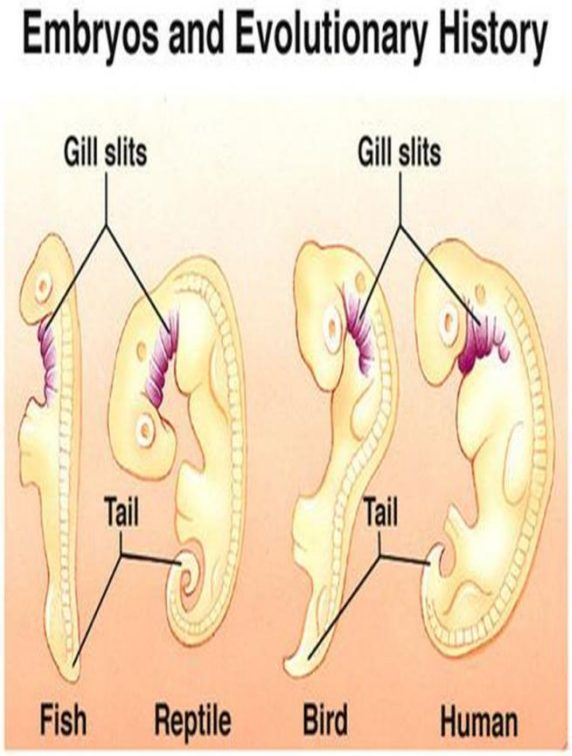
Use iPads

Evidence of Evolution

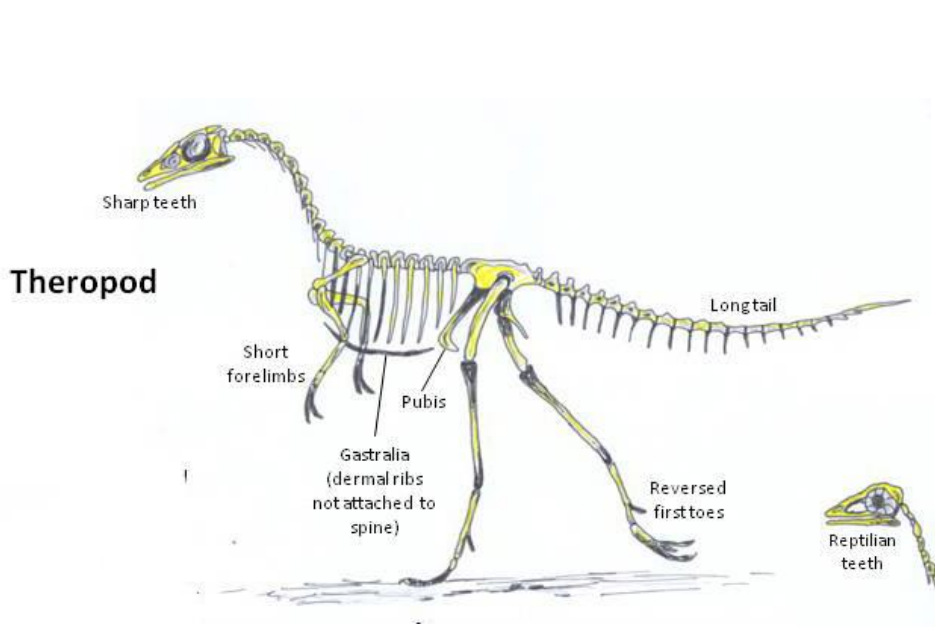
1. Homologous Body Structures
2. Similarities in Embryology
3. Fossil Record
4. Genetics



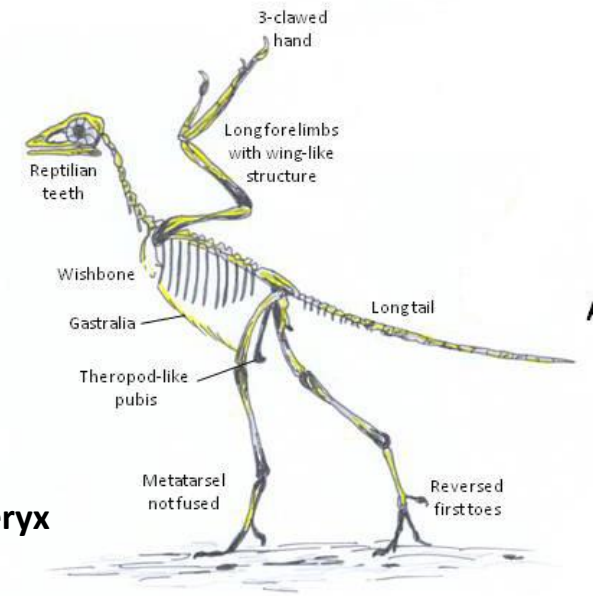




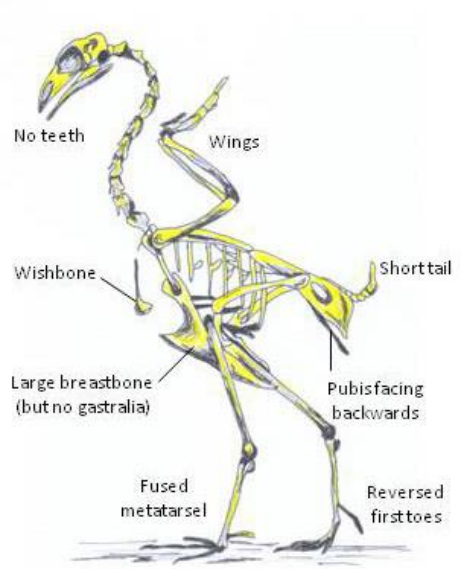
22 features in the skeletons of Theropods (meat-eating dinosaurs) were also found in birds and nowhere else.



Theropod



Archaeopteryx

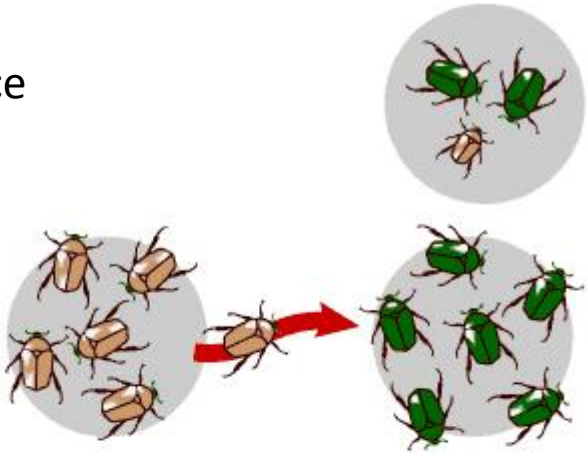


Chicken

Mechanisms of change

Mutation

A gene mutation is a permanent alteration in the DNA sequence that makes up a gene. Heredity vs Acquired (or somatic)



Migration

Individuals moving between populations and moving their genes with them.

Genetic Drift

The change in the frequency of a gene variant (allele) in a population due to random chance.

Natural Selection

The process by which organisms that are best suited to their environment survive and pass their genetic traits on to their offspring.

Genetic variation

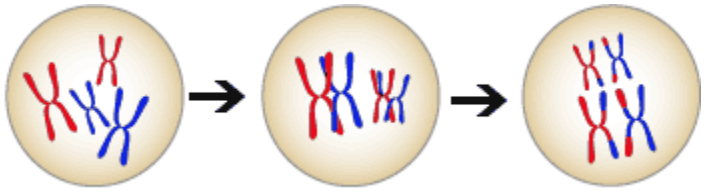
Without genetic variation, some of the basic mechanisms of evolutionary change cannot operate.

There are three primary sources of genetic variation.

1. **Mutations** are changes in the DNA. A single mutation can have a large effect, but in many cases, evolutionary change is based on the accumulation of many mutations.

2. **Gene Flow** is any movement of genes from one population to another.

3. **Sex and reproduction** can introduce new gene combinations into a population. This genetic shuffling is another source of genetic variation.



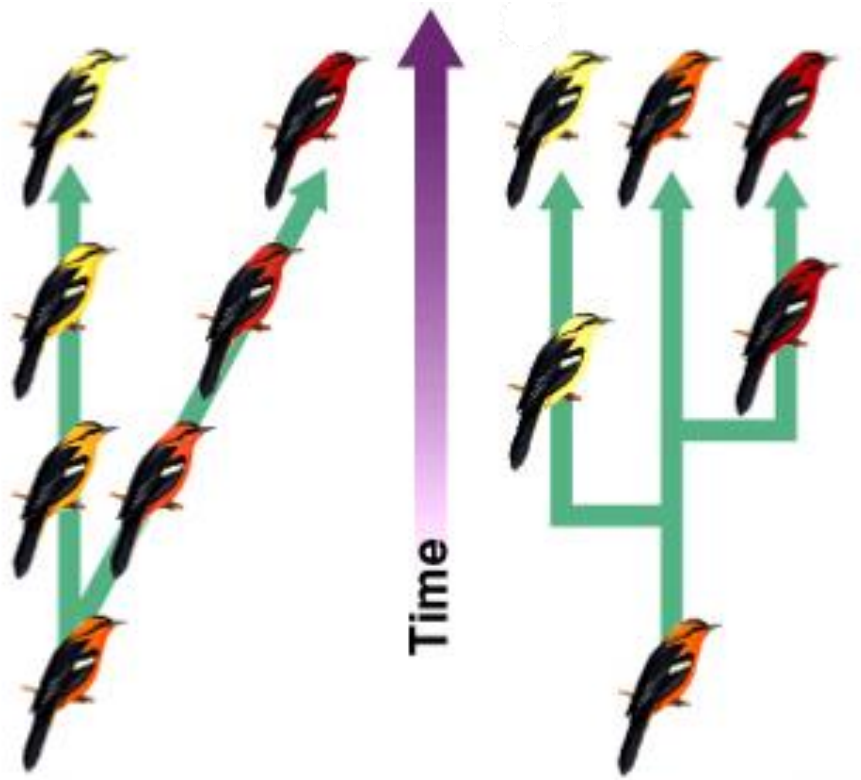
Genetic shuffling is a source of variation.

The Big Idea

Natural selection and genetic drift cannot operate unless there is genetic variation.

If a population of organisms were 100% the same, then selection and drift would not have any effect because their genetic make-up could not change.

Rates of Evolution



Gradualism - a theory that suggests that evolution proceeds in small, gradual steps over long periods of time. An ancestral species is transformed into a new species.

VS

Punctuated Equilibrium - relatively rapid evolution events where a species splits into two or more distinct species, rather than one species gradually transforming into another.

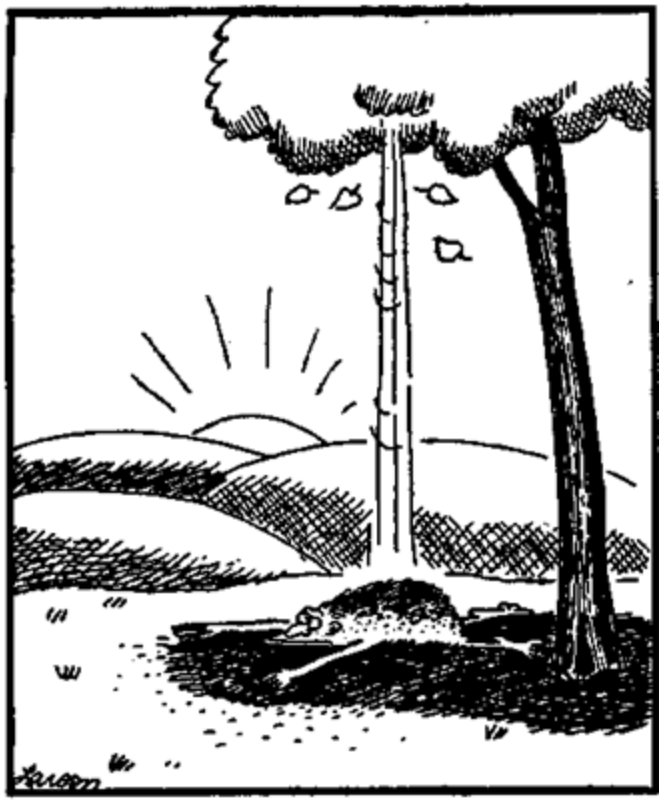
Video: Why does evolution matter?

Additional Reading For

Natural Selection & Evolution

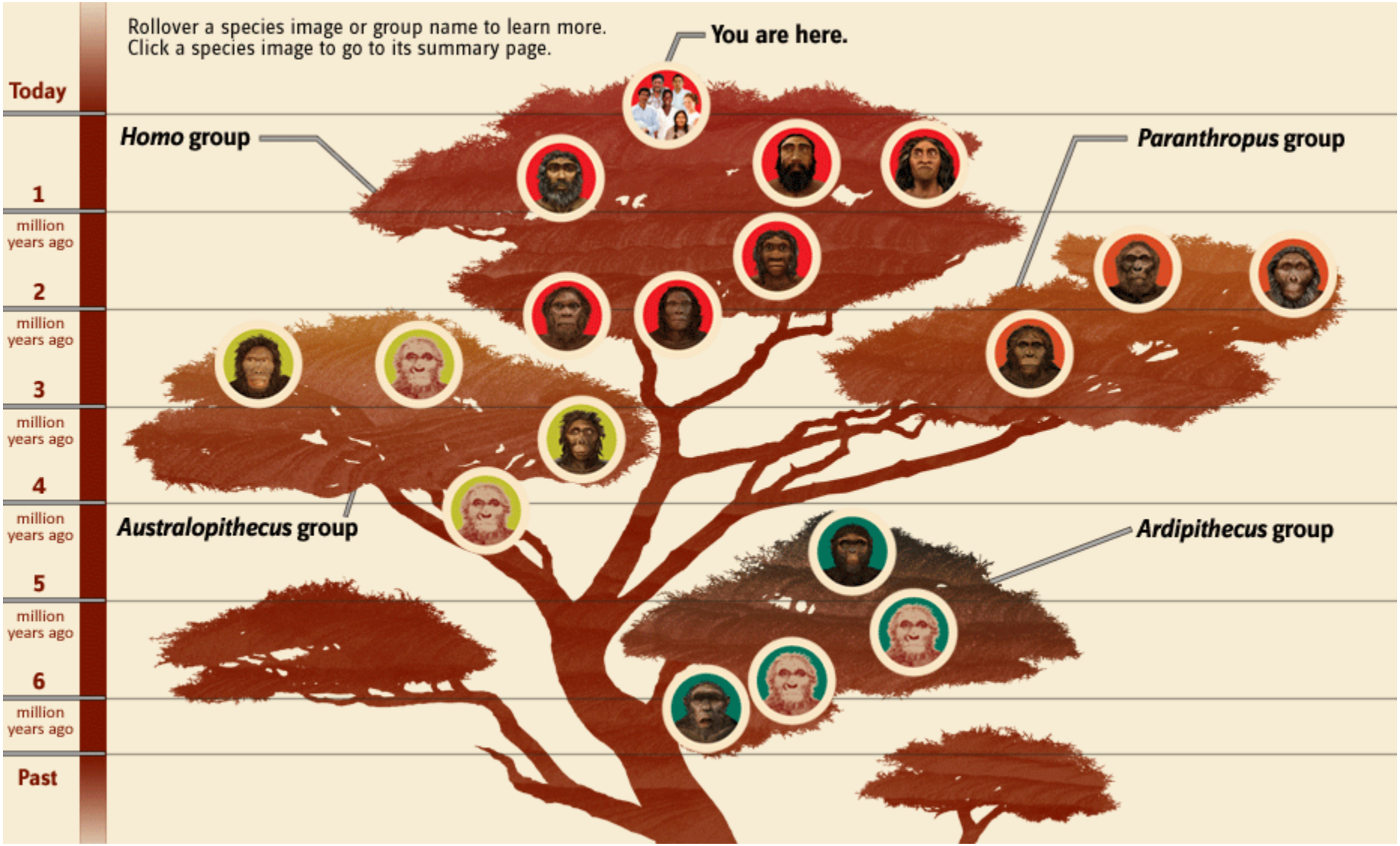
Chapter 15, pp 416-441.

The Hominid Story

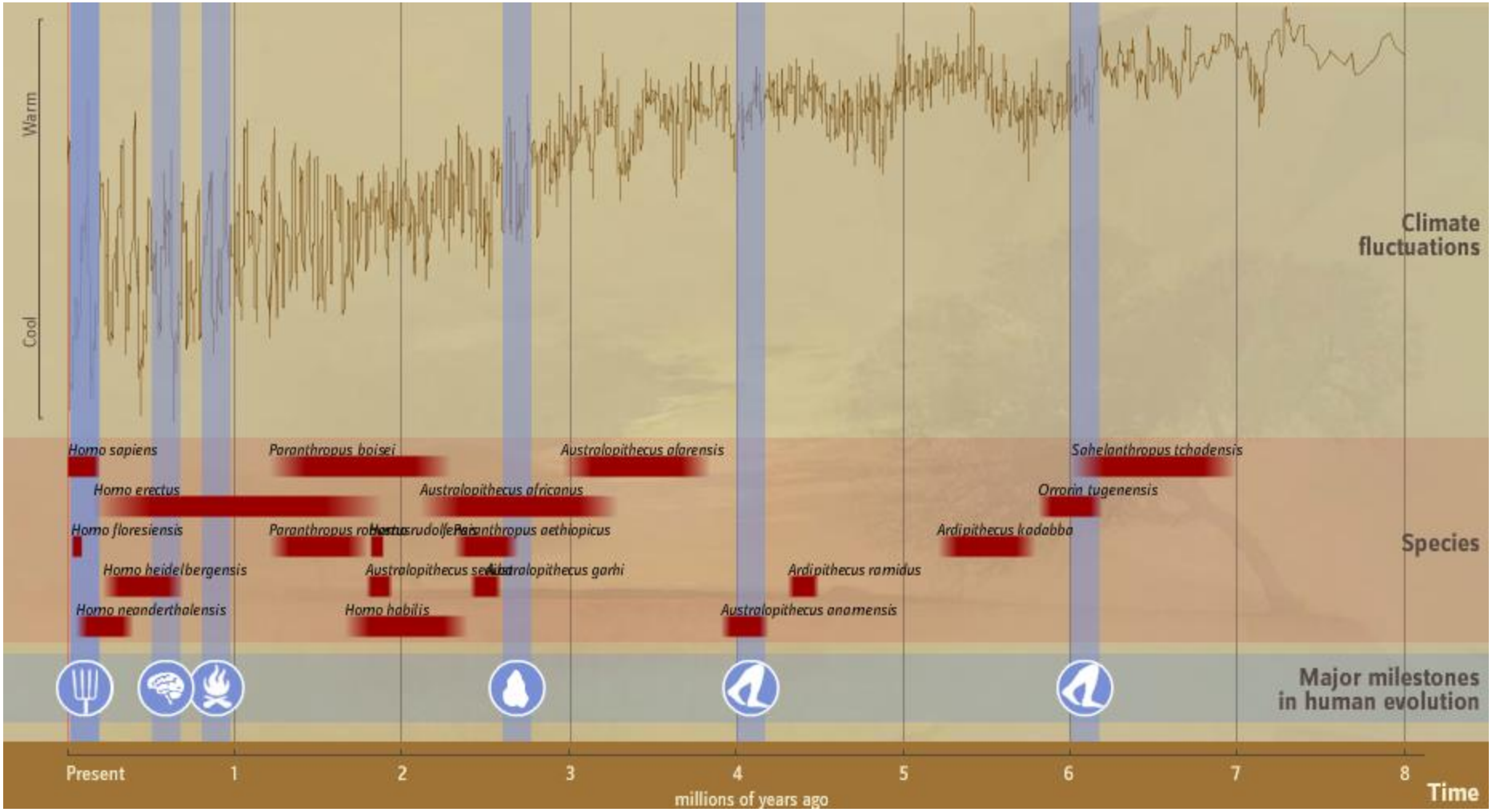


The Dawn of Man

Human Family Tree



Human Evolution Timeline Interactive

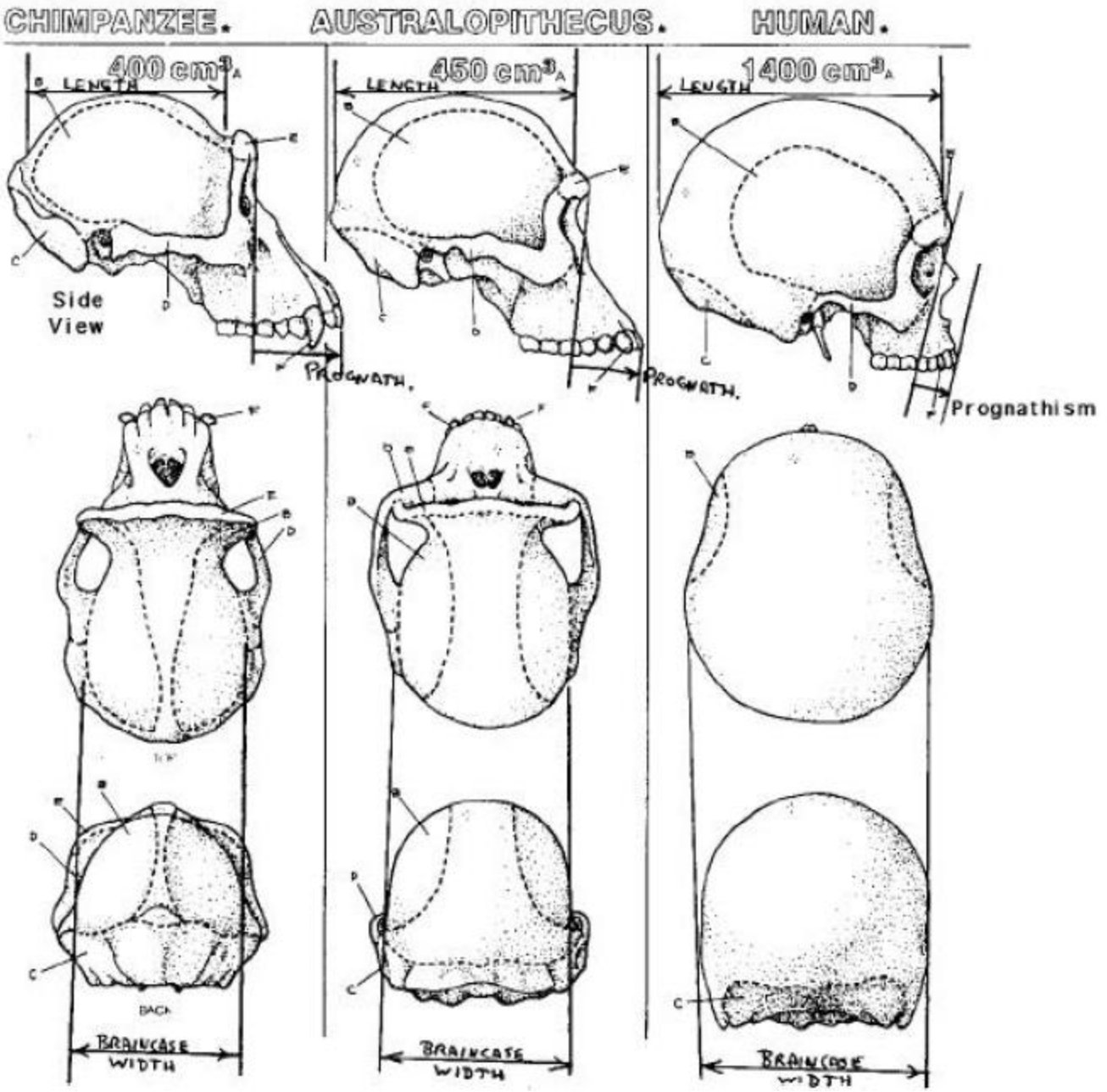


Cranial Clues of Bipedalism:

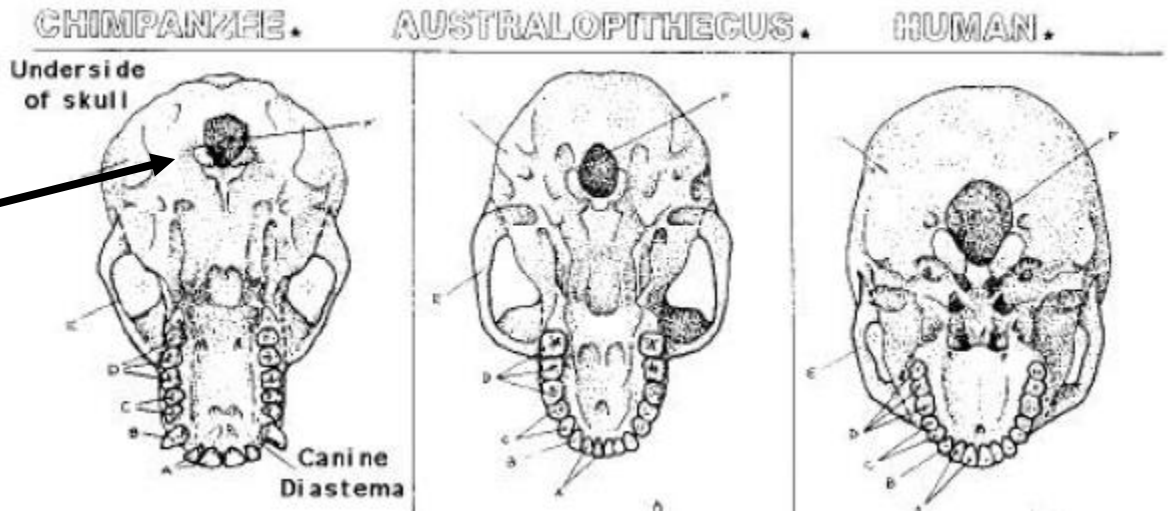
1. shorter canines
2. smaller brow ridges
3. The foramen magnum is found more directly underneath the skull.

Prognathism

Brain Case



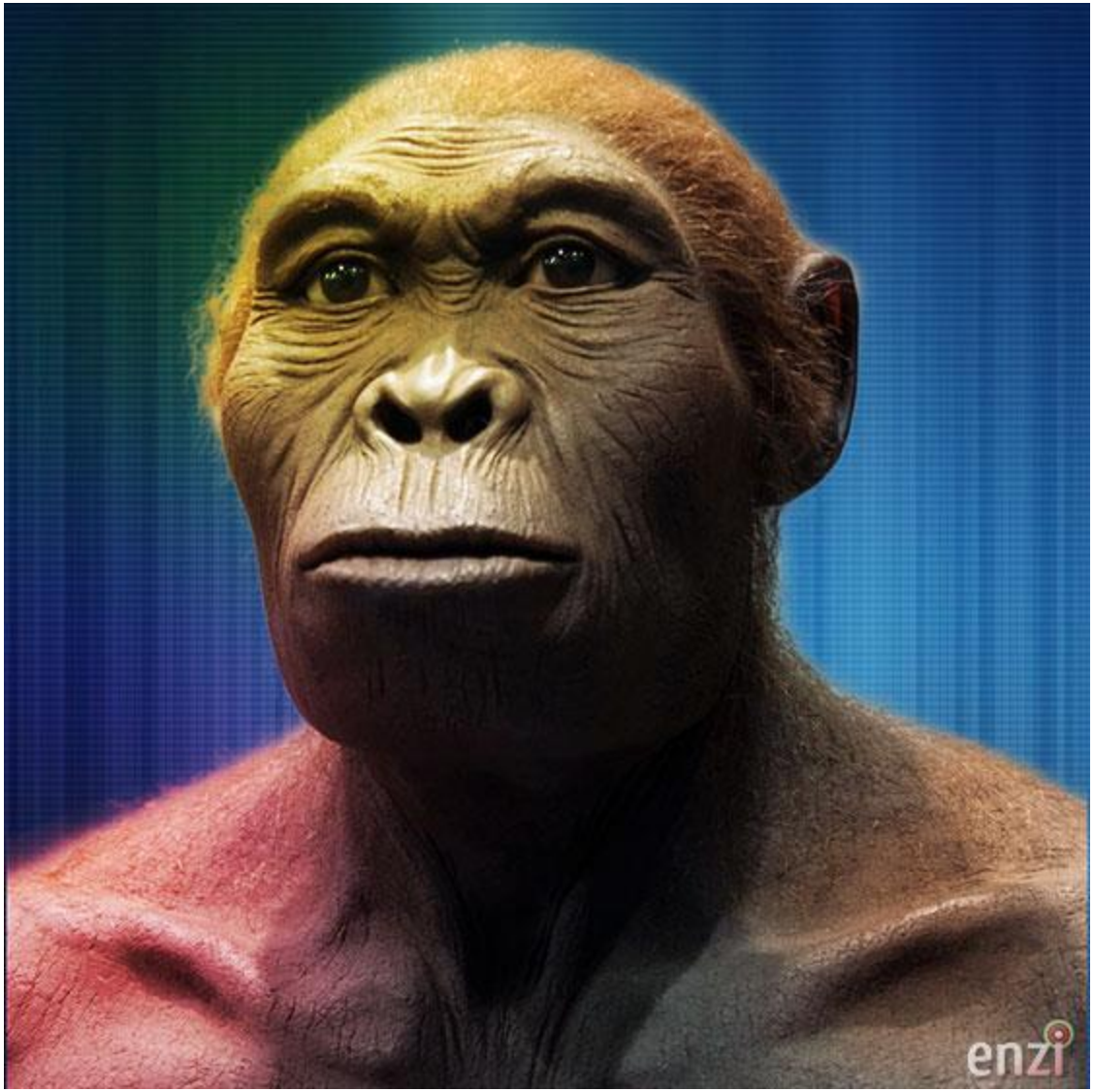
Foramen Magnum



Do Hominid lab

Australopithecus afarensis
3.5 mya

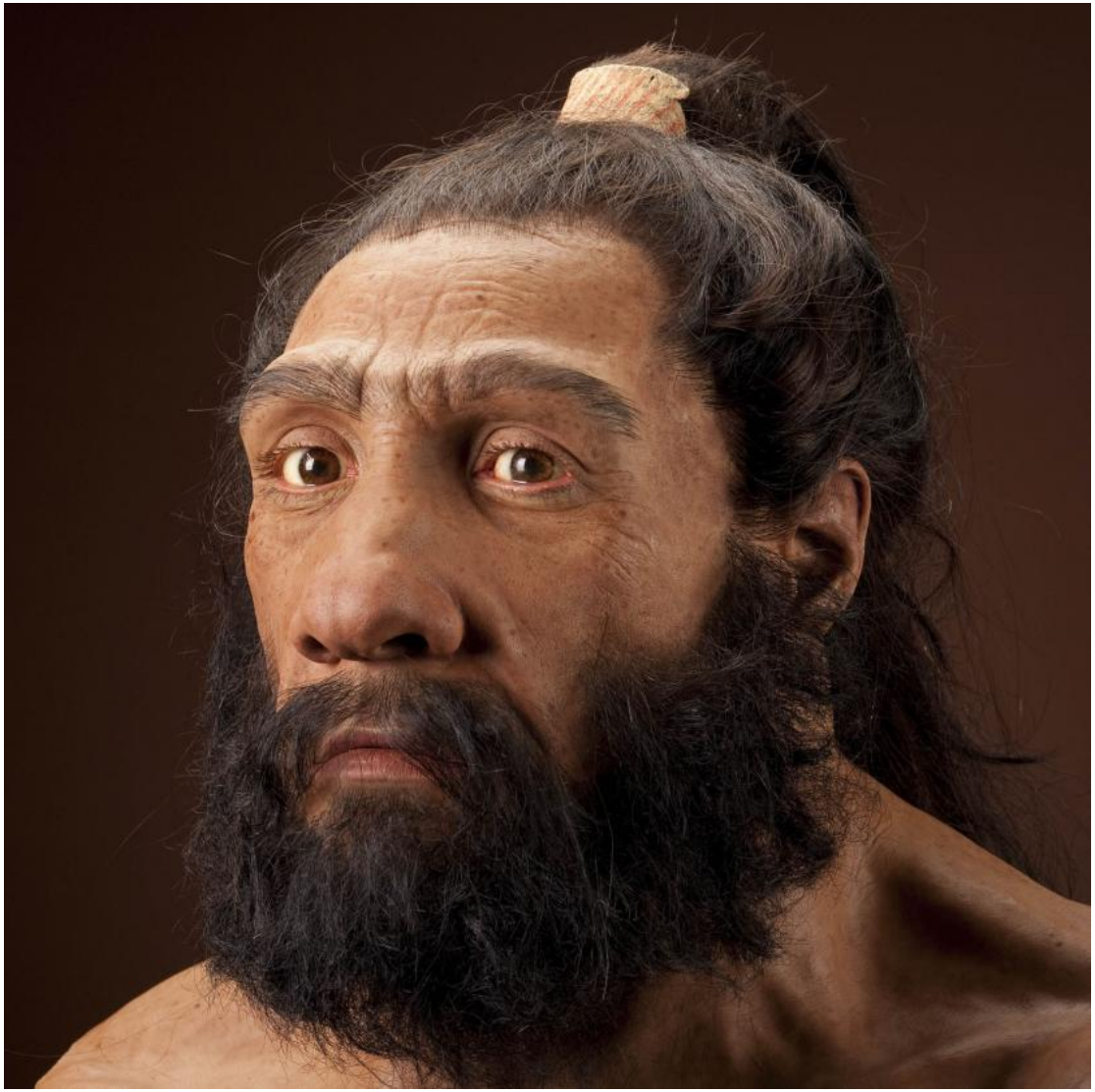
Homo habilis
2.3 -1.7 mya



Homo erectus
1.25-0.3 mya

Homo neandertalensis

350,000 – 30,000 years ago



Homo sapiens

200,000 years ago - present