

The Evolutionary Origins of Genetic Information

Steve Freeland

UHNAI

NASA ASTROBIOLOGY INSTITUTE, UNIVERSITY OF HAWAII



Biological evolution describes a natural process that transfers information from a local environment into the chemical known as DNA. Something similar happens when gravity causes raindrops to form a puddle, and the shape of the ground beneath becomes reflected in the underside of this chemical known as water.

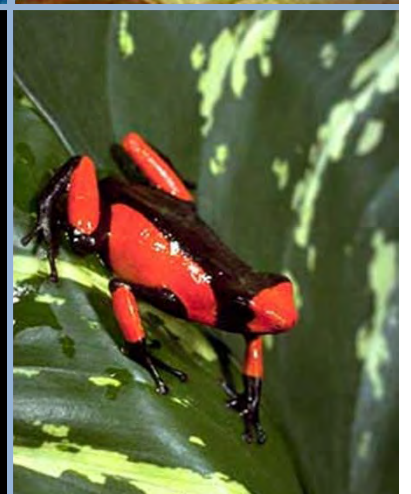
“The Origin of Genetic Information” Perspectives on Science & Christian Faith (2011) , Vol.63(4)



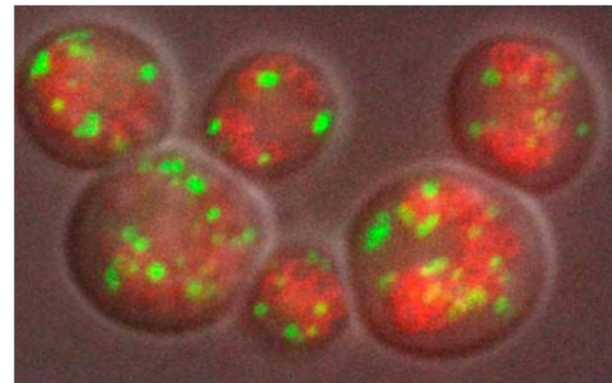
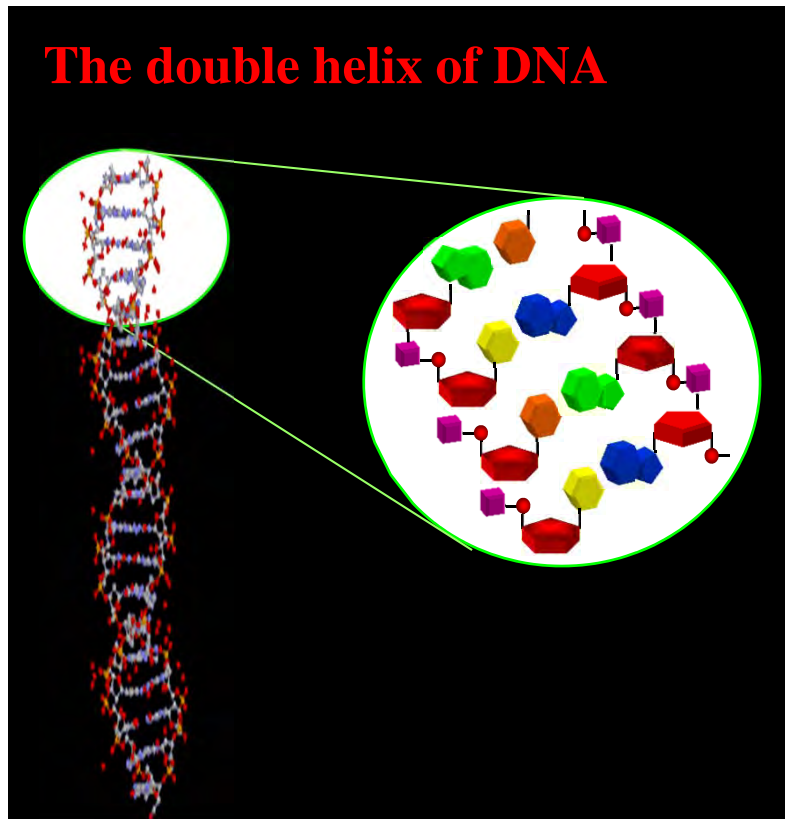


Clearly, biological organisms carry a lot of non-random information ...

Can natural processes account for the emergence of new genetic information?

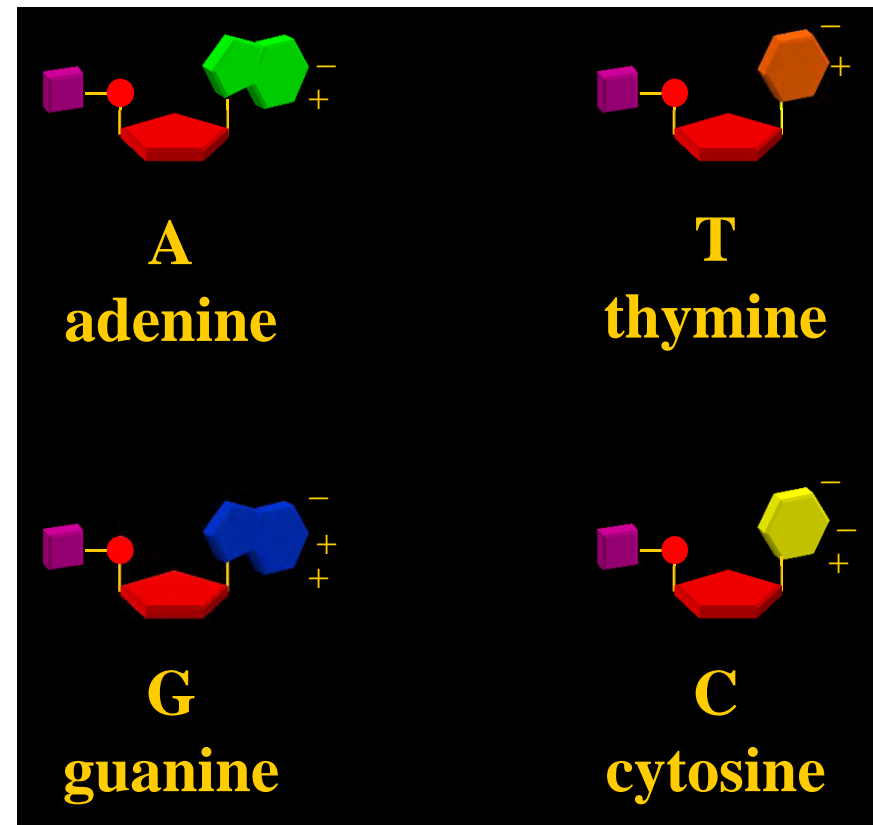
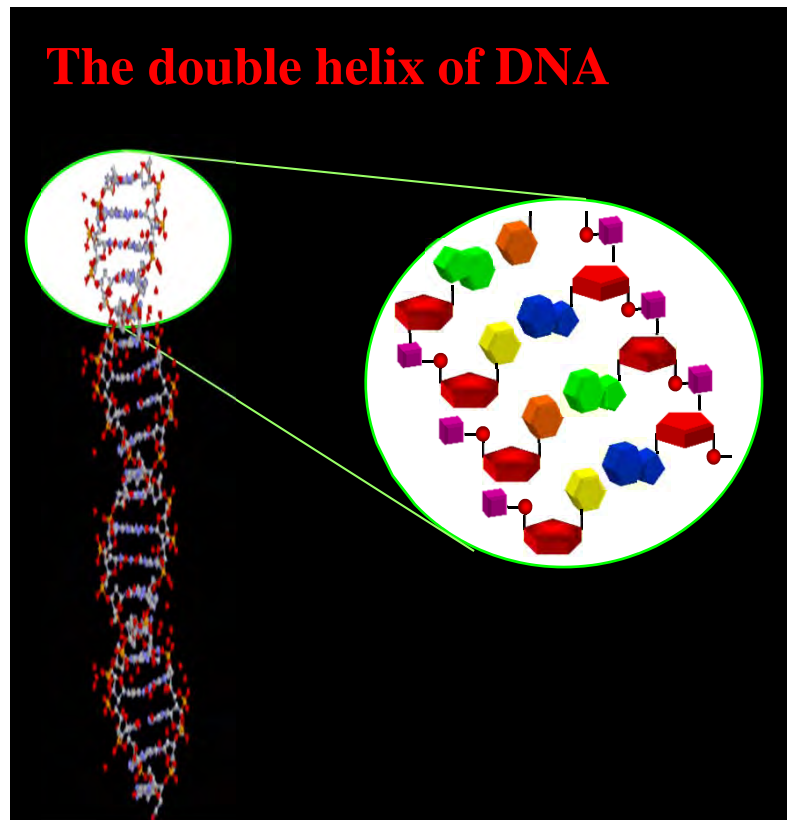


Natural processes can clearly increase genetic information by making new copies...



From us reproducing, to individual cells dividing to the molecular processes by which DNA makes copies of itself...
no disagreement here!

...In fact, well-understood molecular processes can transform any genetic sequence into any other

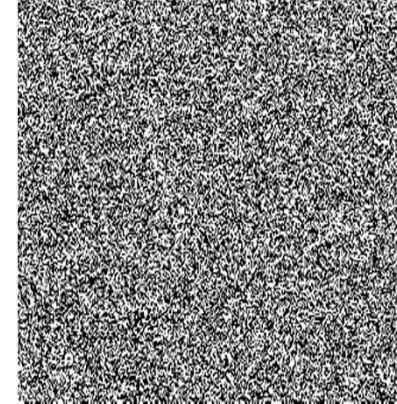
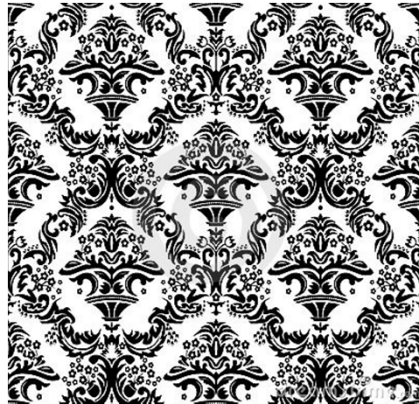
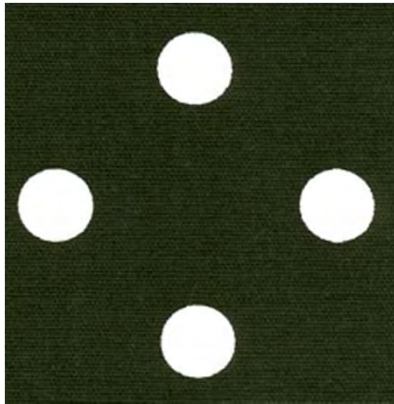


Abundantly documented/studied mutations (often errors made during the copying process) can substitute any one nucleotide for any other, or add or delete nucleotides:

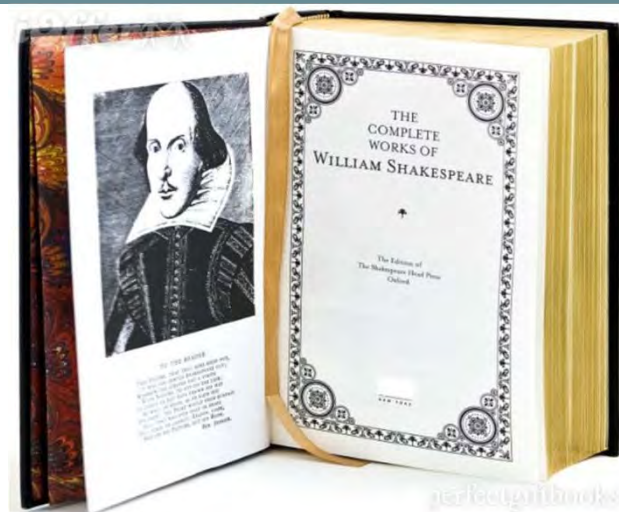
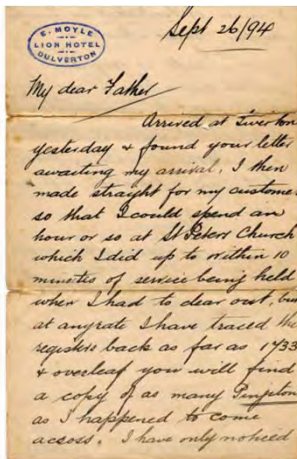
Again, no disagreement here!

But what exactly *is* (genetic) information?

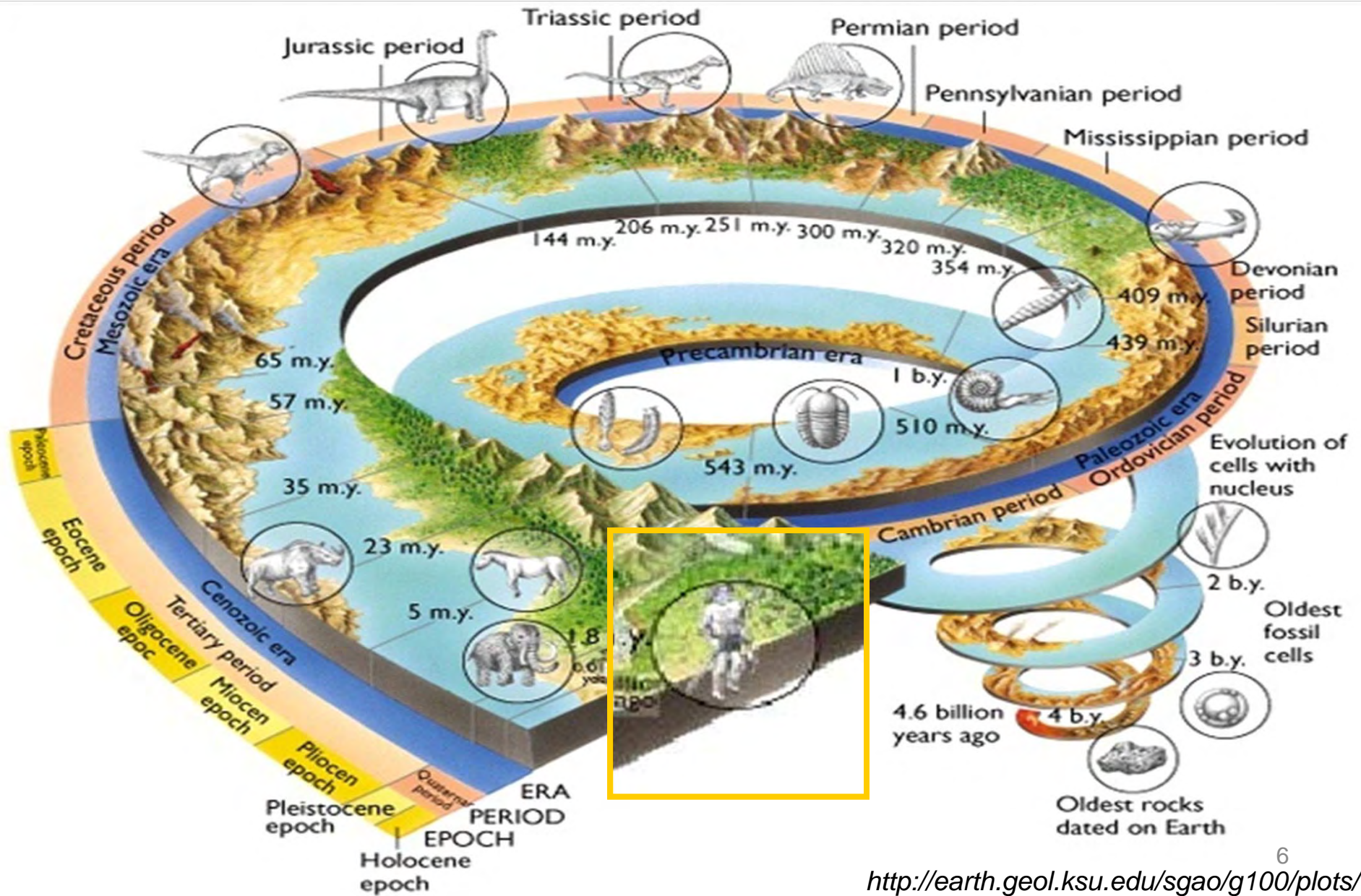
Q#1: Which of these pictures contains the most information?



Q#2: Which of these texts contains the most information?

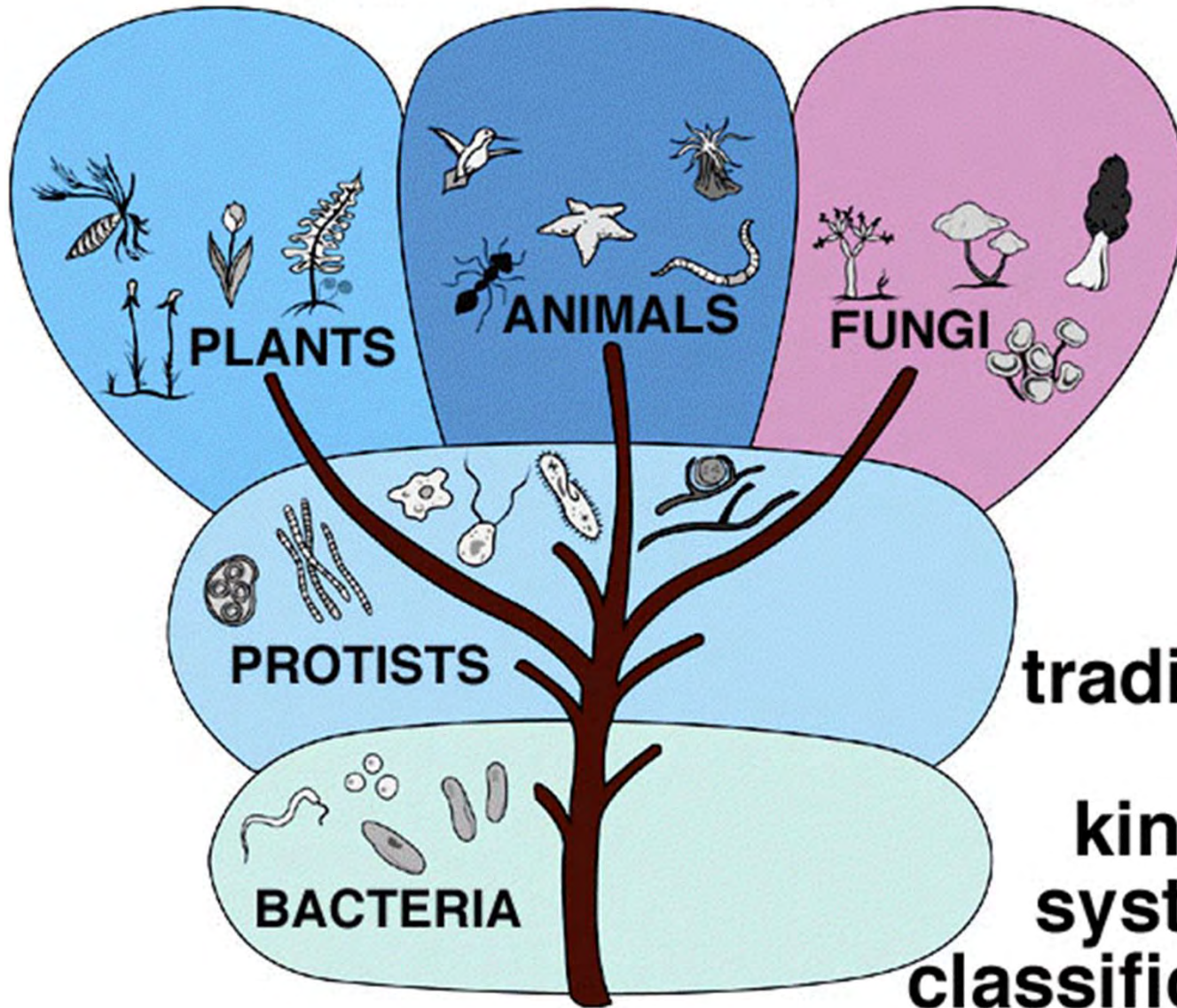


Does evolution increase genetic information?



A classical view of life's diversity

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

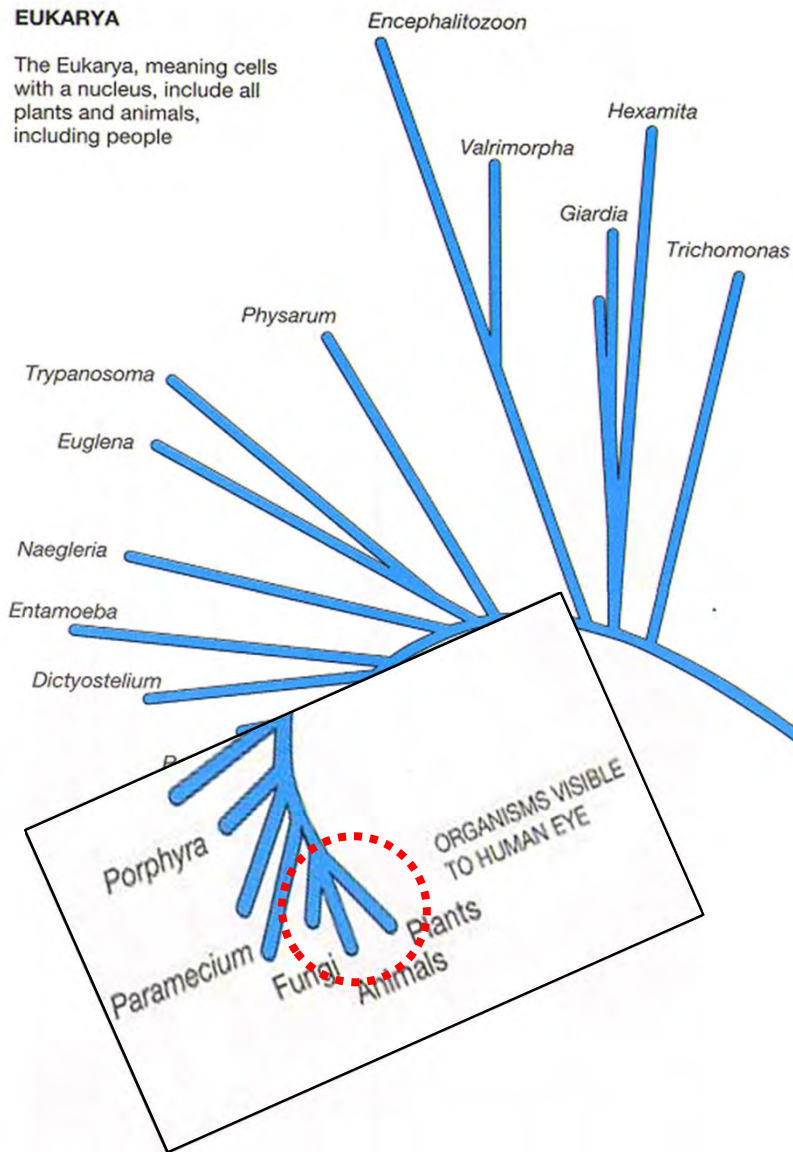


**The
traditional
five-
kingdom
system of
classification**

A modern, *objective* view of life's diversity

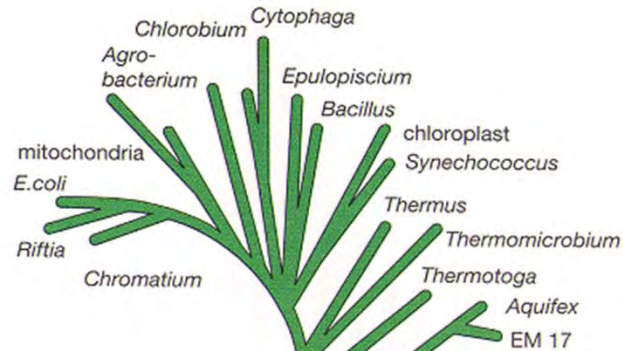
EUKARYA

The Eukarya, meaning cells with a nucleus, include all plants and animals, including people



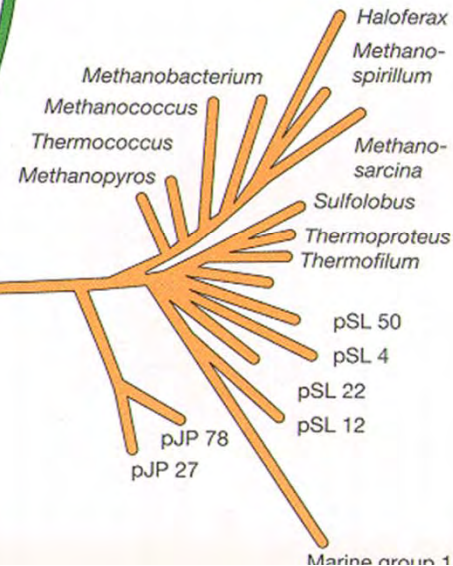
BACTERIA

Bacteria are single-celled organisms with no nucleus.



ARCHAEA

The Archaea look like bacteria but have different genes for managing and reading out their DNA.

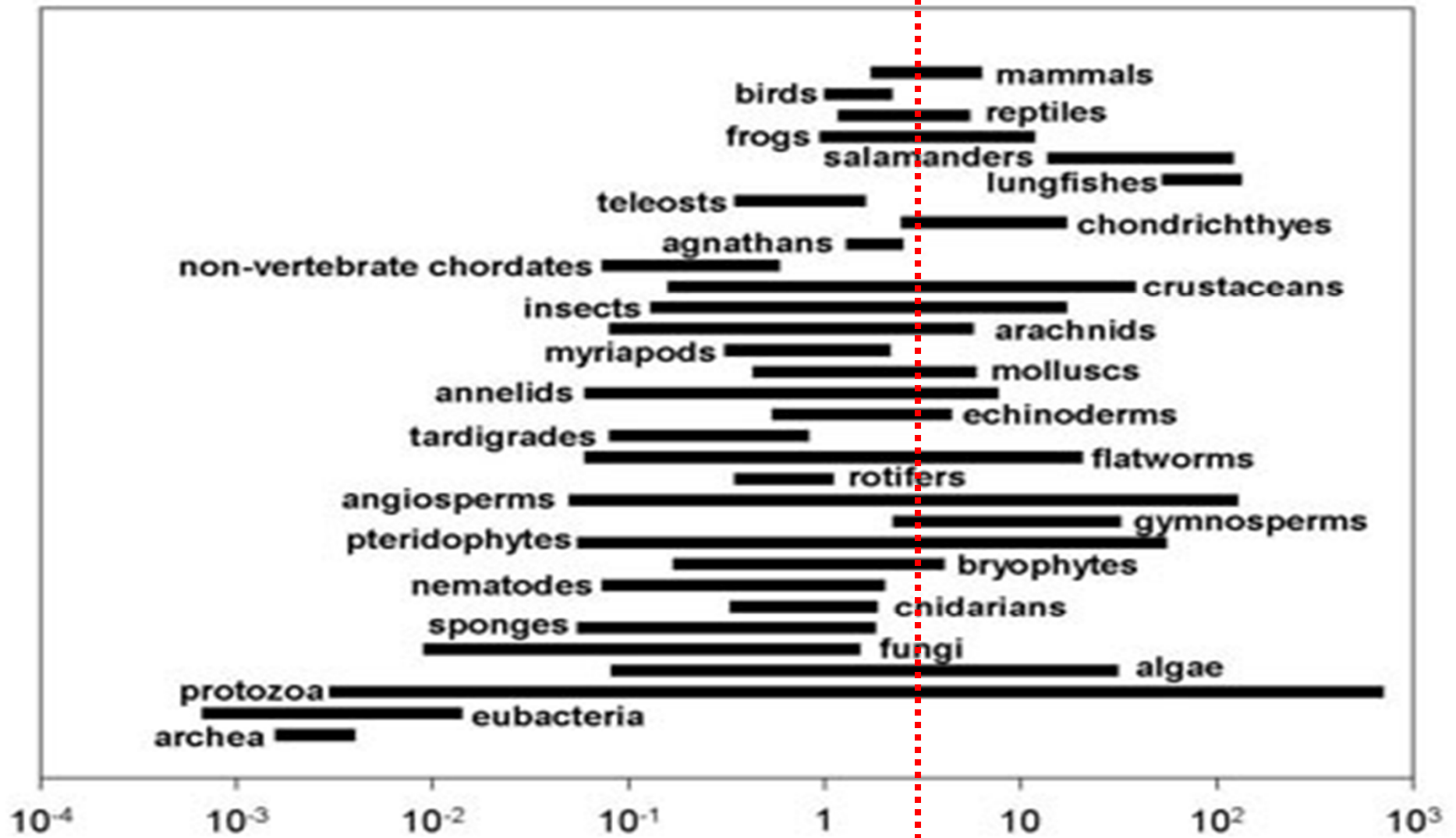


Adapted from Carl Woese and Norman R. Pace, *New York Times*, April 14, 1998

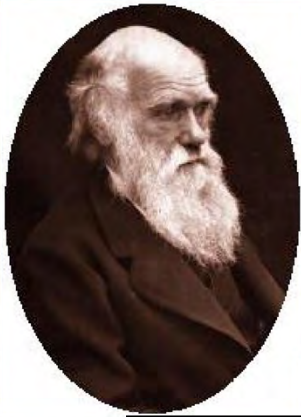
Humans show no clear signs of genetic “superiority”

<http://www.genomesize.com/statistics.php>

Humans



Qty of genetic information (log₁₀ Mb of “single copy” DNA)



Darwin used the word evolution exactly once in the whole of the Origin of Species:

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

“Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving...directly follows. There is grandeur in this view of life... that ... from so simple a beginning endless forms most beautiful and most wonderful have been, and are being,

evolved

*Exon, Bromley, Kent,
October 24, 1881.*

LONDON:
JOHN MURRAY, ALBEMARLE STREET.

1859.

Copyright of Darwin's Origin of Species

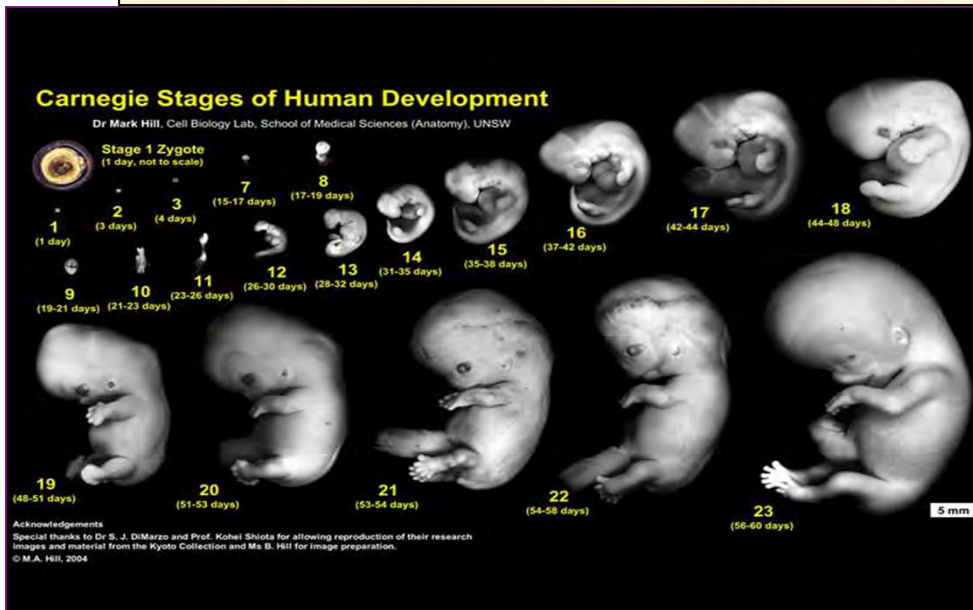
- Literally the final word of the final paragraph of the final chapter...

The word “evolution” is *pre*-Darwinian!

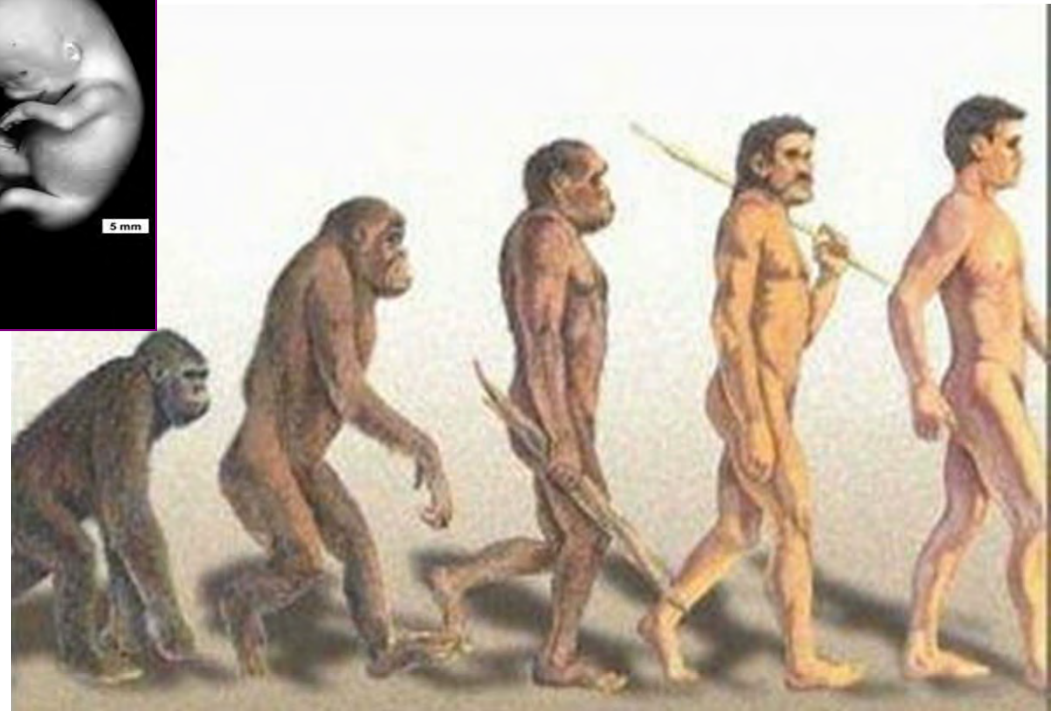
“Evolution”

From Latin *evolvere* “to unroll”

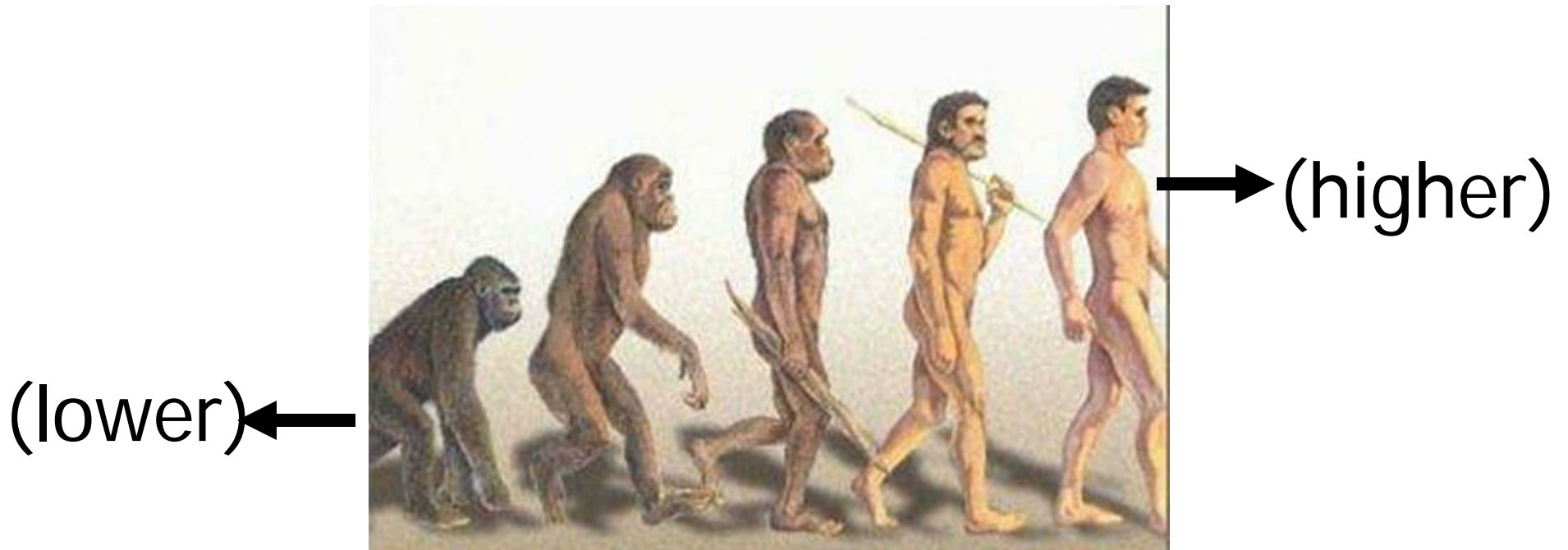
This word entered the English language via pre-Darwinian developmental biologists



Who likened *progressive development of zygote into adult with progressive development of simple species into more complex species*



The “ladder of evolutionary progress”



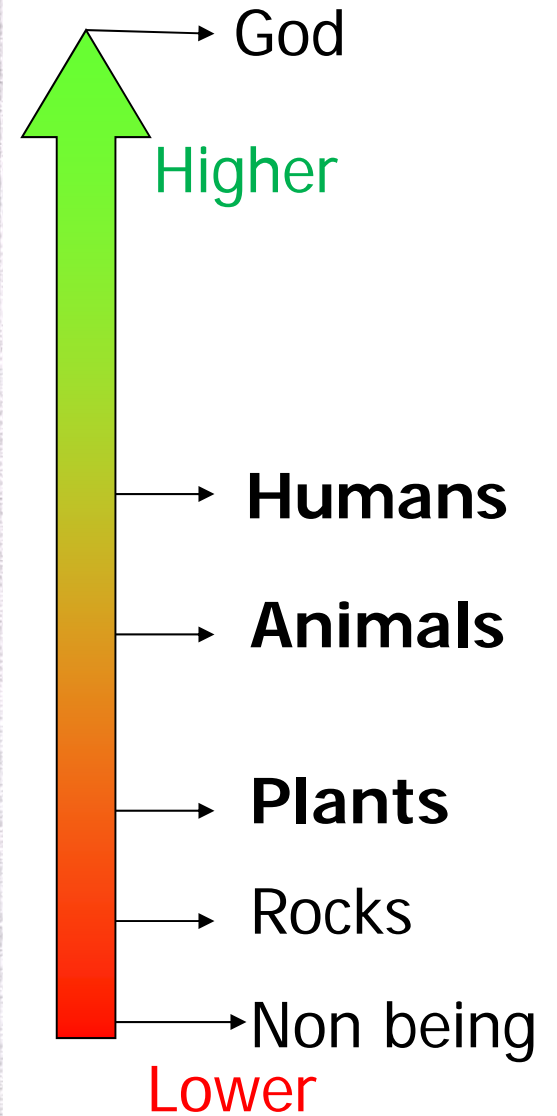
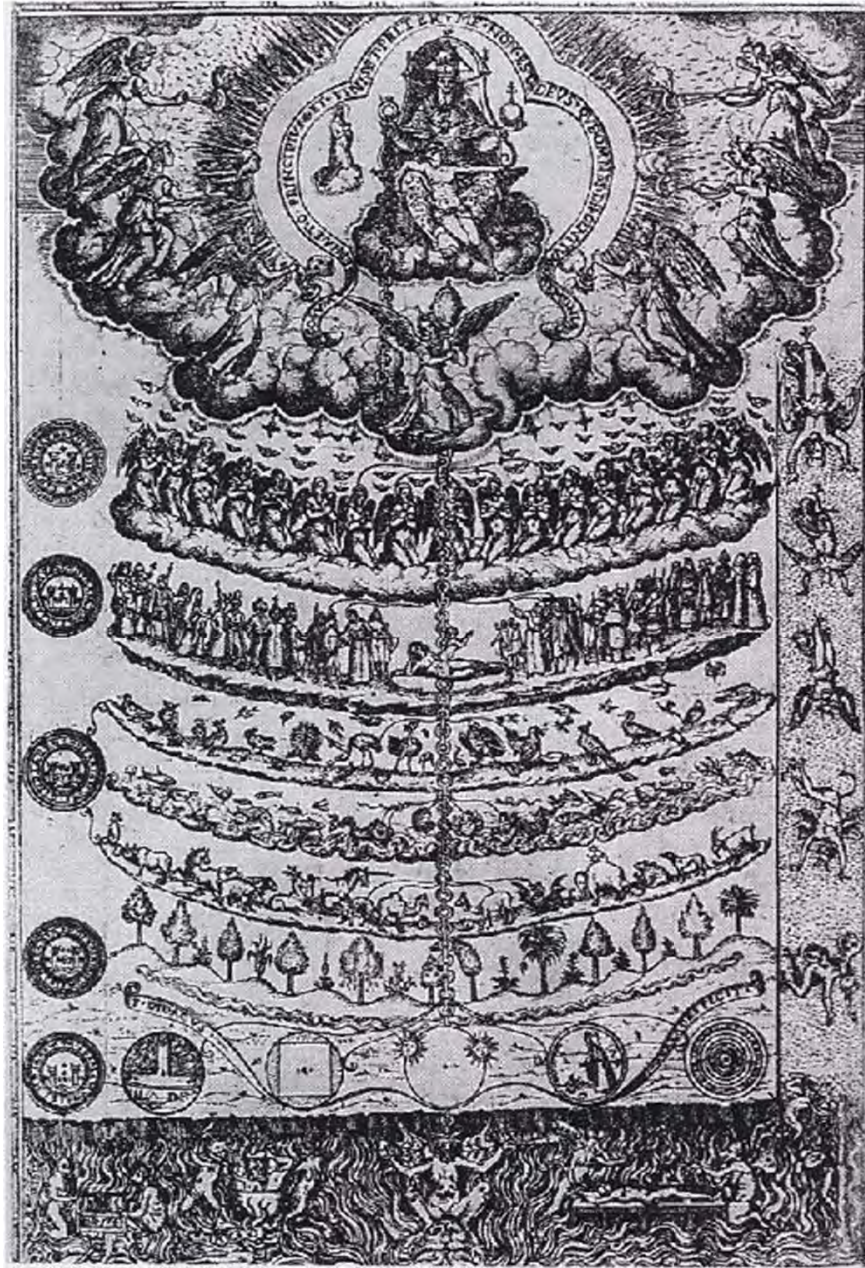
... implies that each living species is somewhere, higher or lower, on an measurable scale...

This idea has deep, deep roots within our culture

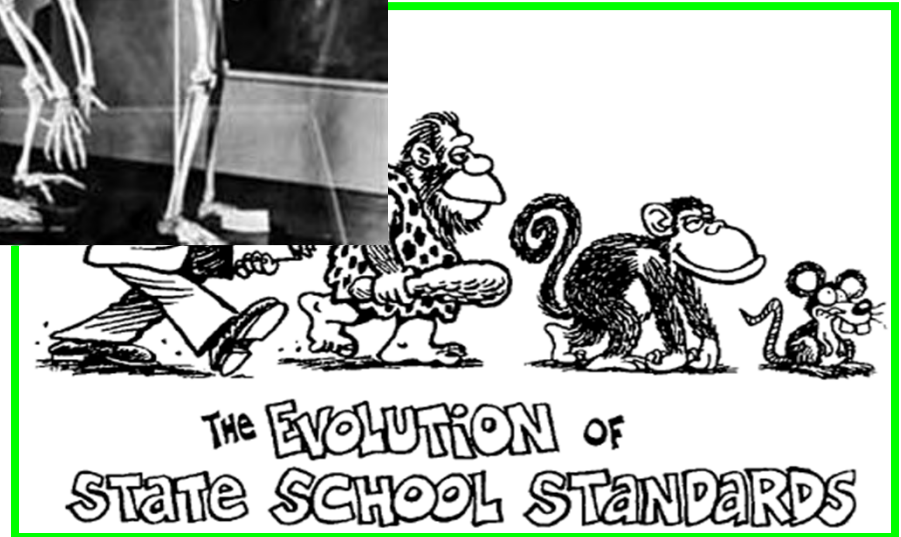
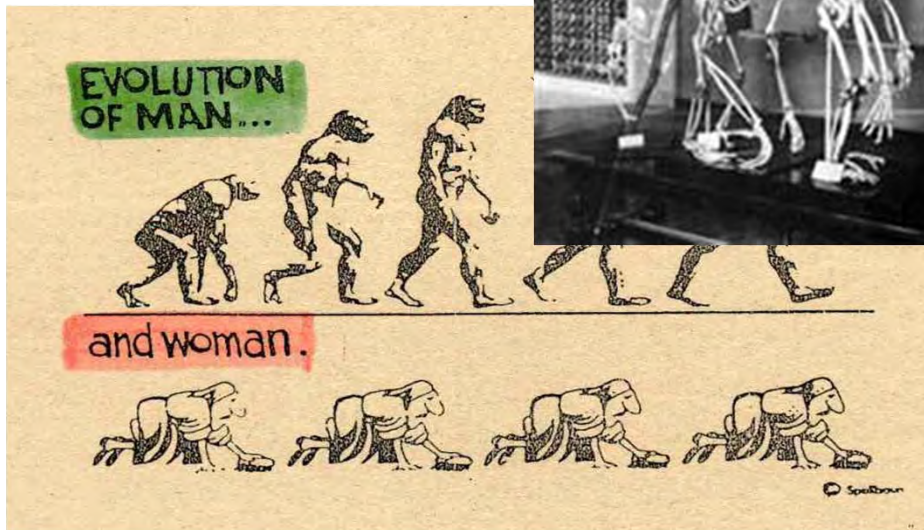
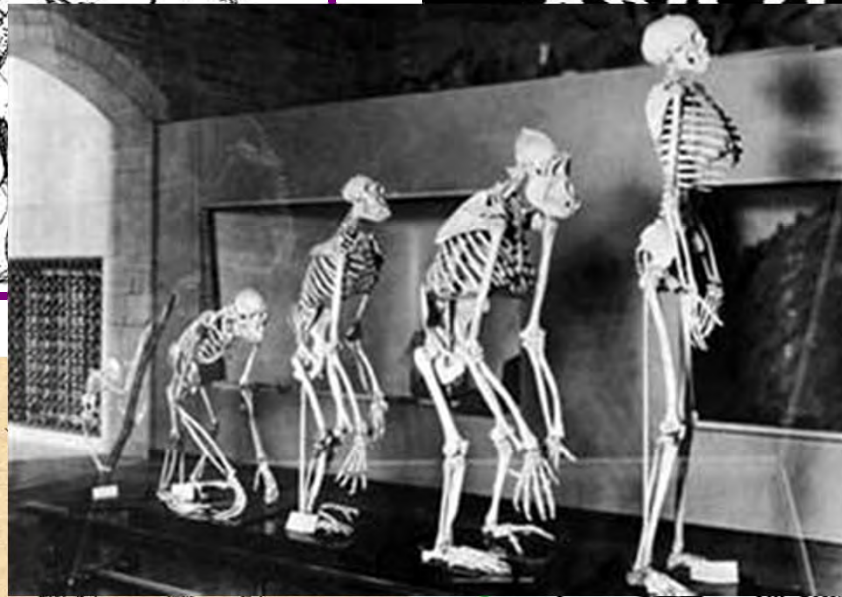
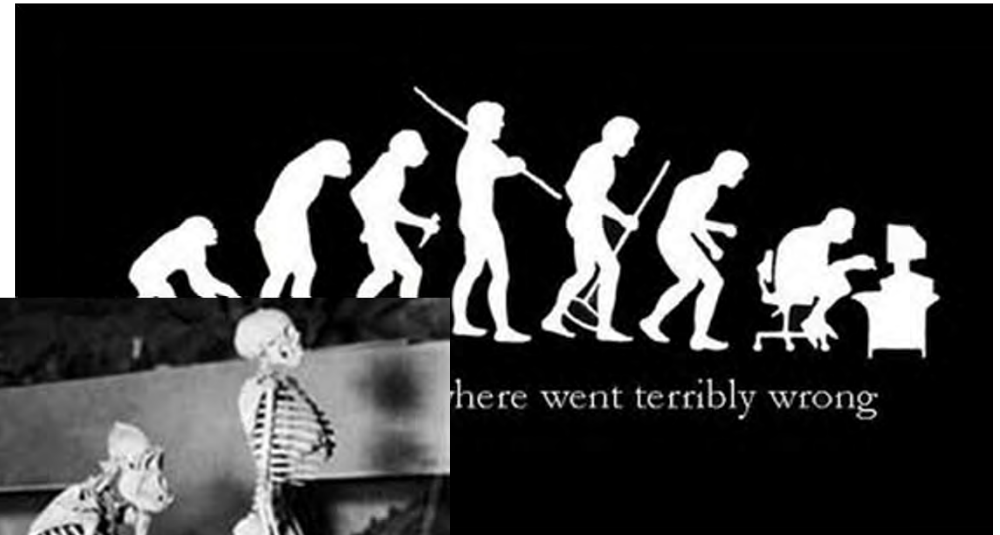
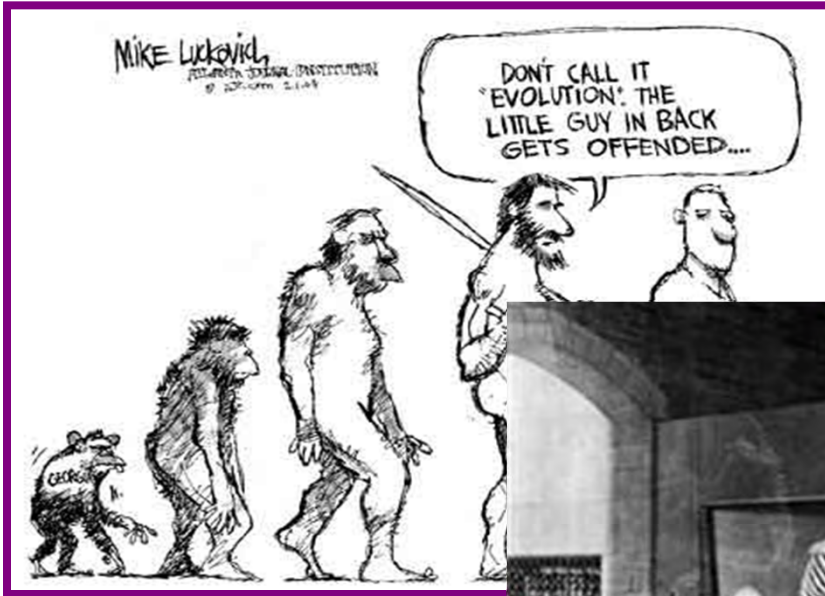


The
“*Scala
Naturae*”

(the Great
Chain of
Being)

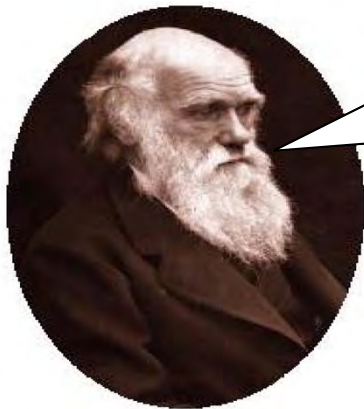


And enormous penetration that is hard to dispel...



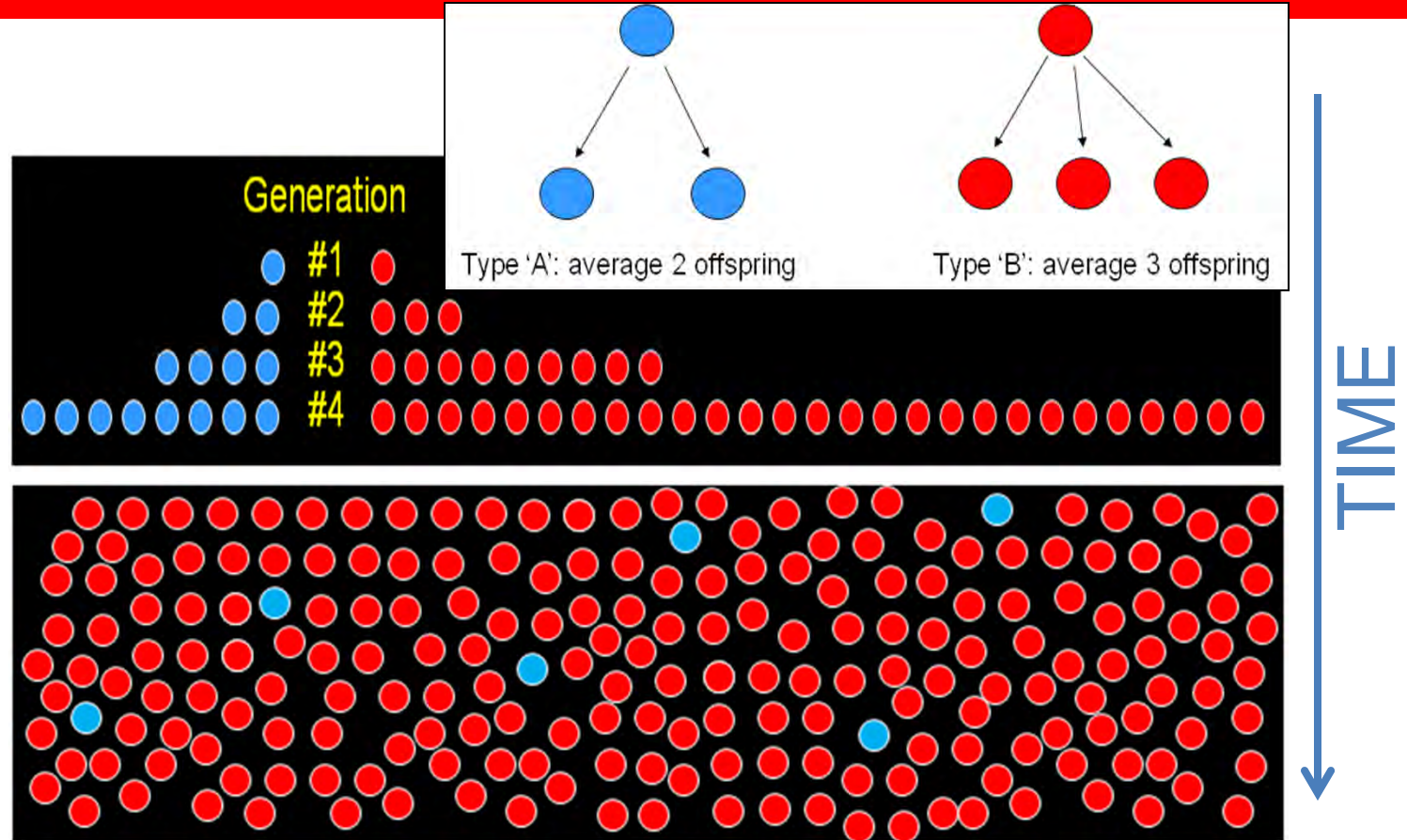
What Darwin actually said...

- More individuals are born than can survive
- These individuals vary from one another
- These variations are inherited from parents to offspring

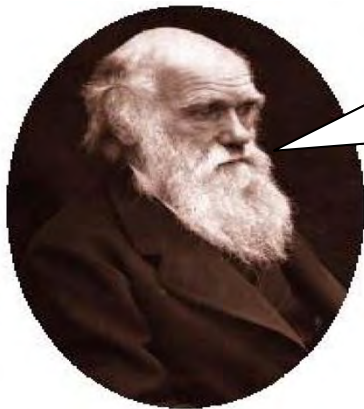


“Where there is a struggle for existence within a population of organisms, inherited variations that improve reproductive success will increase over time”

What Darwin actually said...

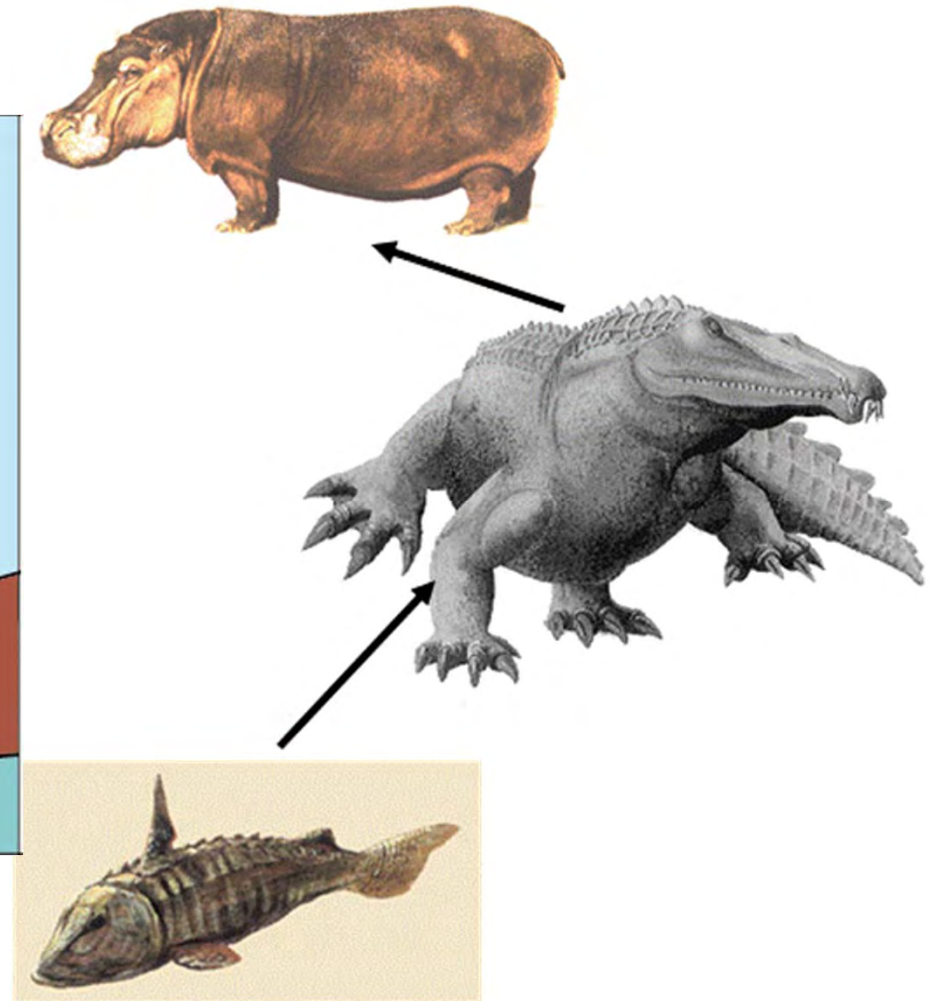
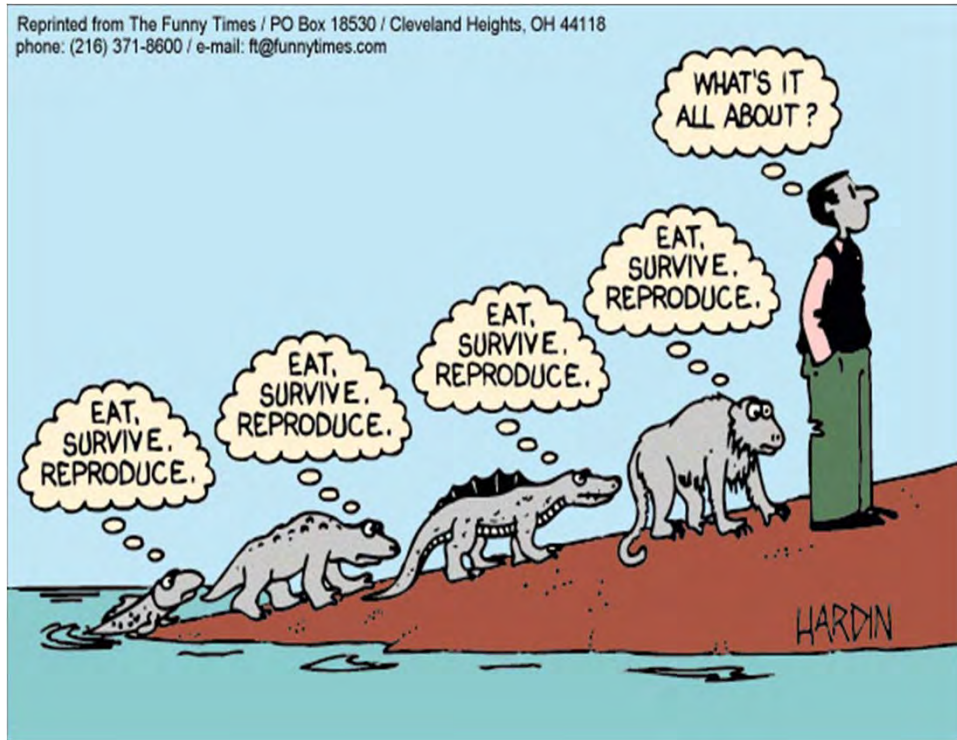


(nothing here says that "red" is more complex or sophisticated)



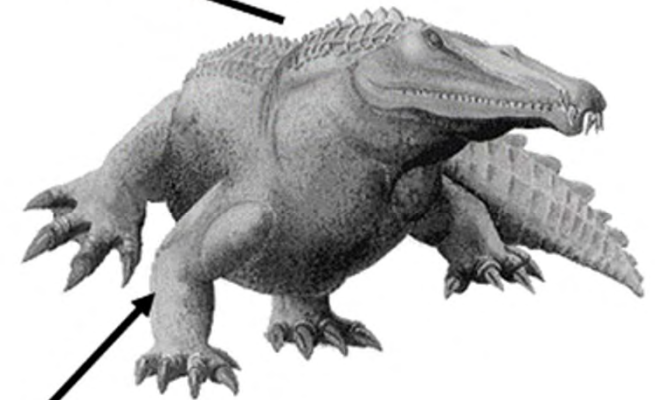
“Where there is a struggle for existence within a population of organisms, inherited variations that improve reproductive success will increase over time”

Example: progress from water to land?



Progress: from fish to reptiles to mammals?

Progress from water to land? (not necessarily!)



Evolutionary theory has discovered no metric of “progress” that applies within biology...

Natural selection has no intrinsic tendency to increase complexity

cave-fish: *Astyanax mexicanus*



Evolutionary theory has discovered no metric of “progress” that applies within biology...

But genetic information *can* evolve new semantic content



If life on Earth evolved from chemistry (and/or physics), then it *appears* that life has generated (semantic) genetic information

A syllogism

P1: All books contain non-random information created by an intelligent designer (author)

P2: The phenomenon I am looking at contains information like a book

=> *The phenomenon I am looking at was created by an intelligent designer*

P1: All dogs have 4 legs, teeth, fur and a tail

P2: The animal I am looking at has 4 legs, teeth, fur and a tail

=> *The animal I am looking at is a dog*

So where does new genetic information come from?



“The leafy sea-dragon is a fish that has evolved to look like sea-weed in order to avoid being eaten by predators”

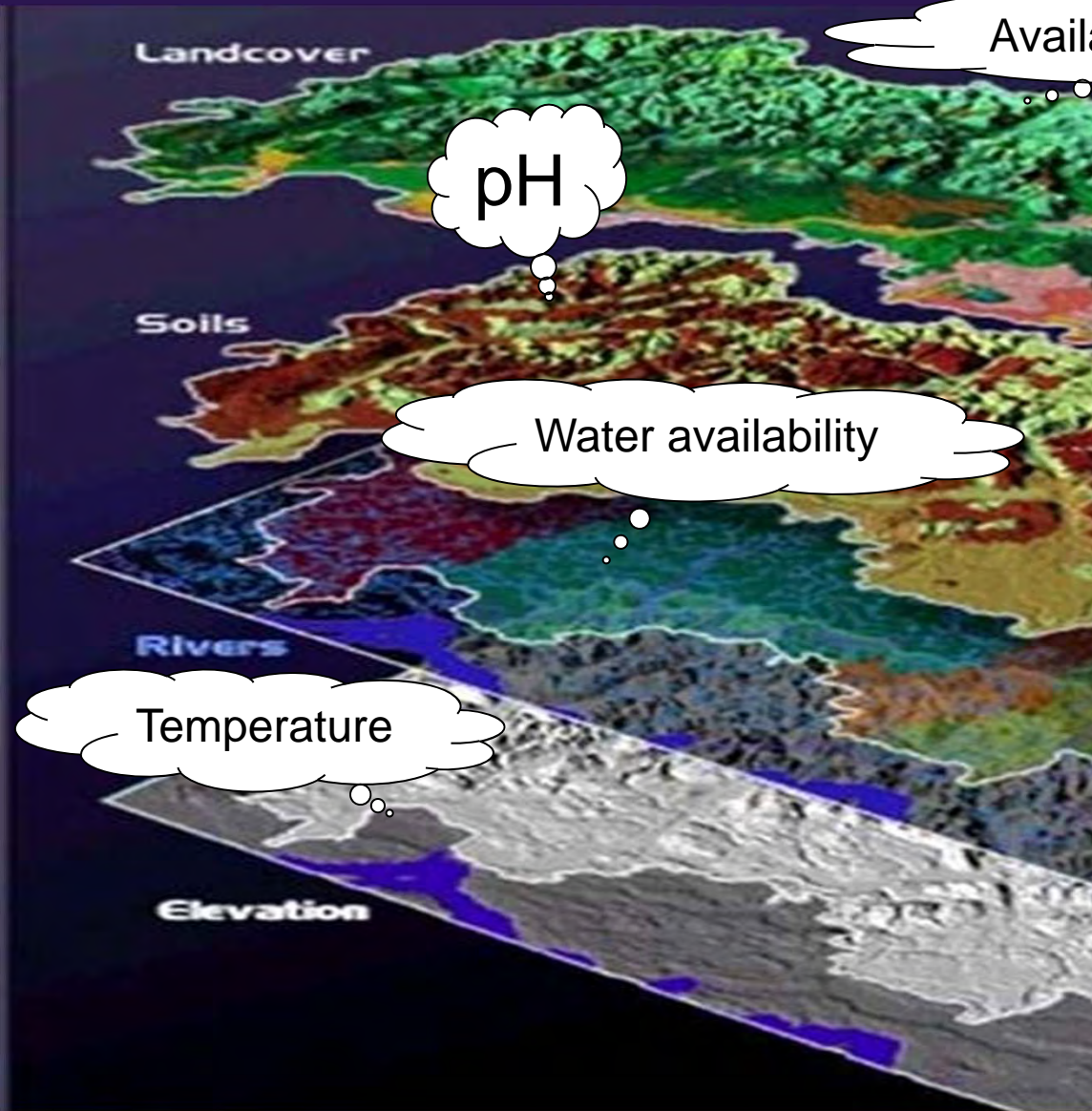
So where does new genetic information come from?



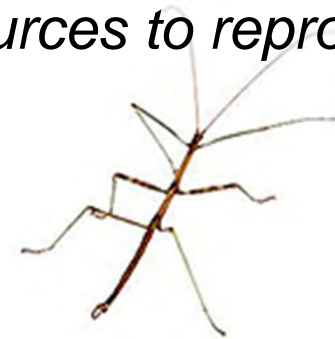
“The leafy sea dragon is a fish that has evolved to look like sea weed in order to avoid being eaten by predators”

“The ancestors of this fish that looked more like seaweed (survived and reproduced more than their relatives who looked less like seaweed”

The source of new “semantic” genetic information is the environment

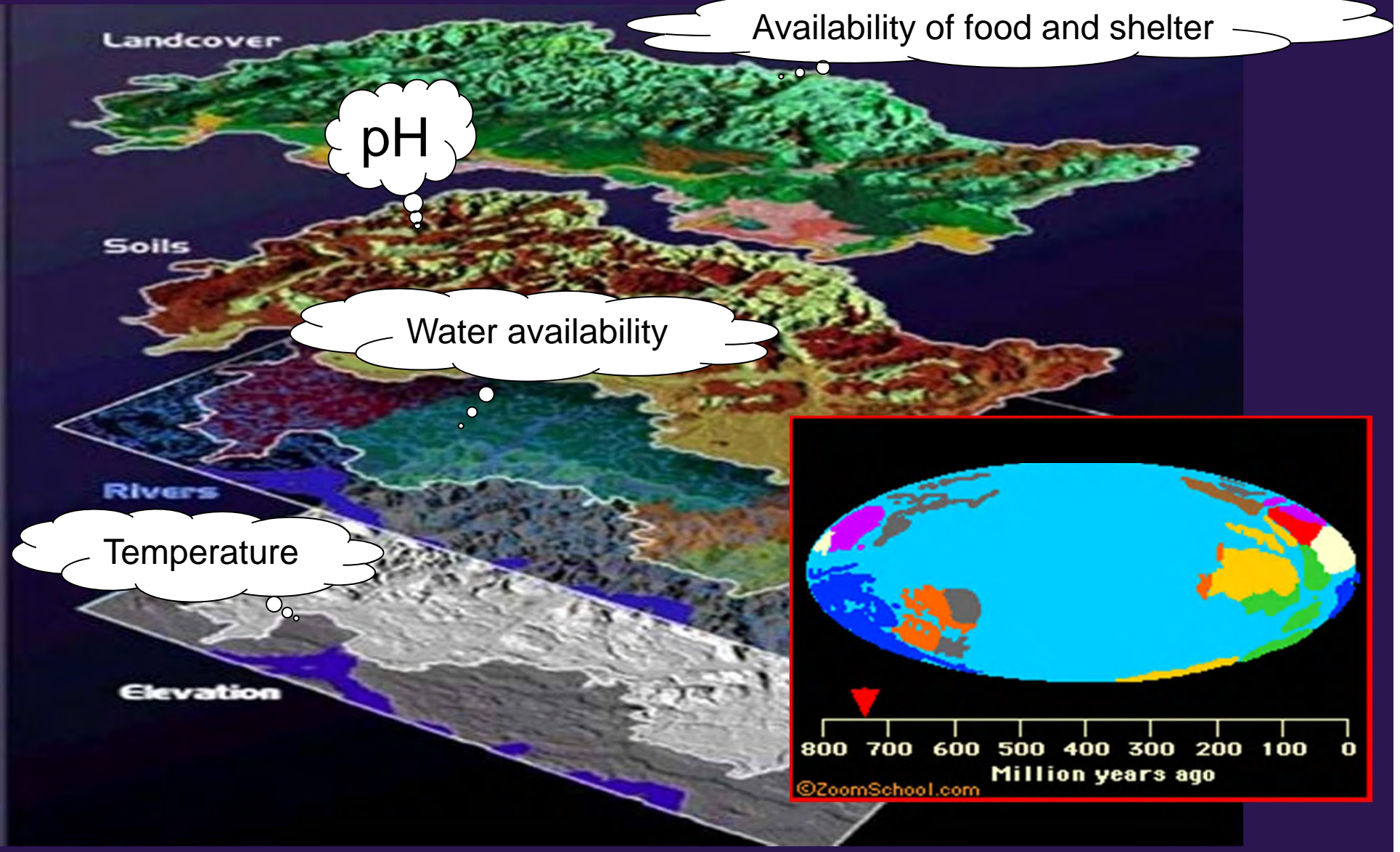


‘good’ and ‘bad’ genetic variations exist only relative to a context: the environment in which the organism is competing for resources to reproduce...

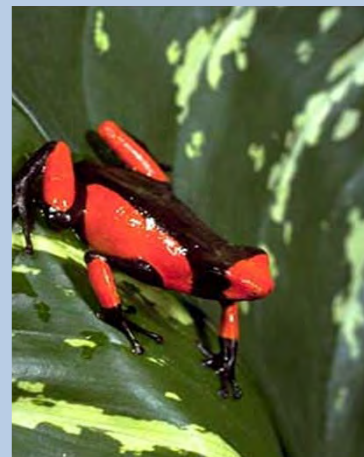
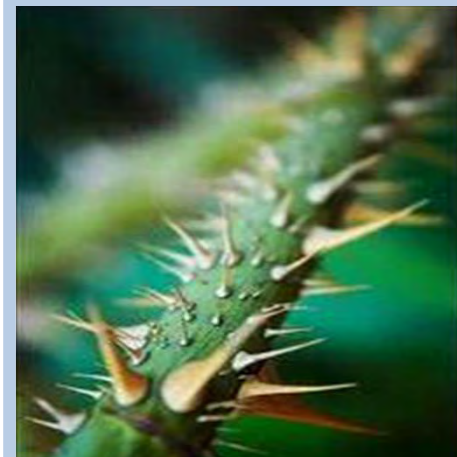


The “fittest” organism is the one that best “fits” (reflects/ matches) its environment

The environment is highly complex and always changing



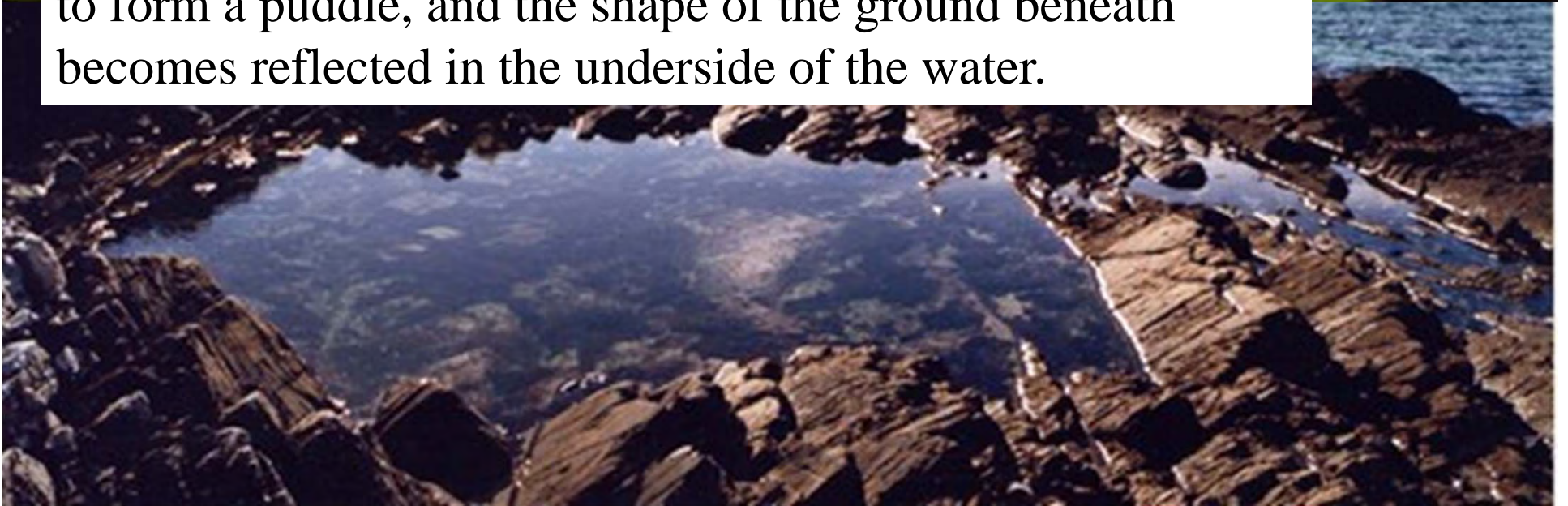
Much of an organism's environment is defined by
other organisms



Predators, prey, mates, competitors, symbionts, parasites, infections – all these other changing, evolving entities create reflections of reflections of reflections of the environment...



Biological evolution describes a natural process that transfers information from a local environment into DNA. Something similar happens when gravity causes raindrops to form a puddle, and the shape of the ground beneath becomes reflected in the underside of the water.



**Evolution does not create information – it produces
“images” of the semantic information of the
universe – images that are beautiful, complex and
different from one another ...**



**Now what, in the name of radical,
transforming grace, are we doing here?**