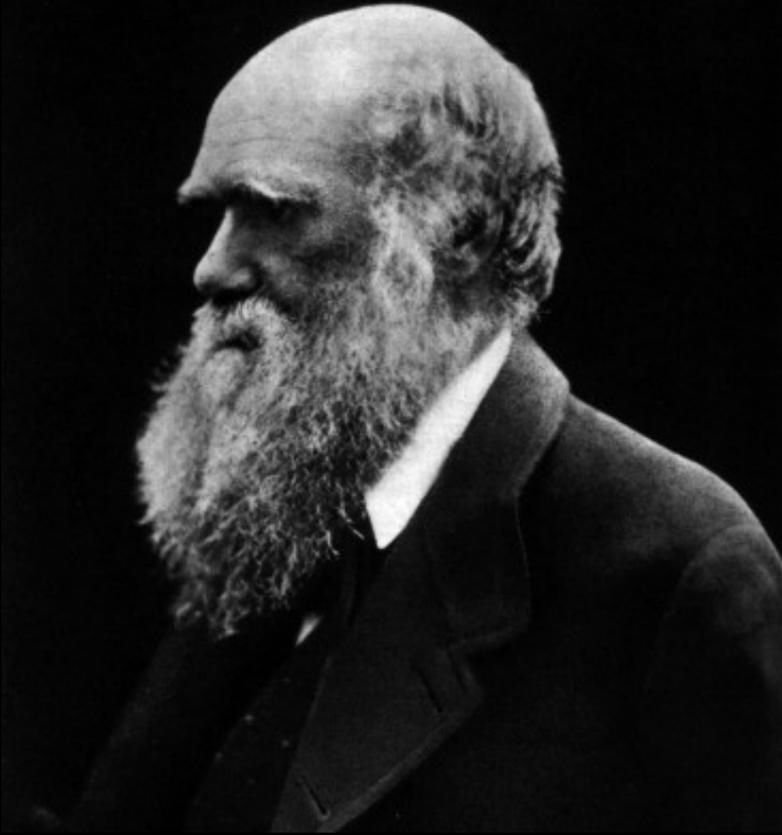


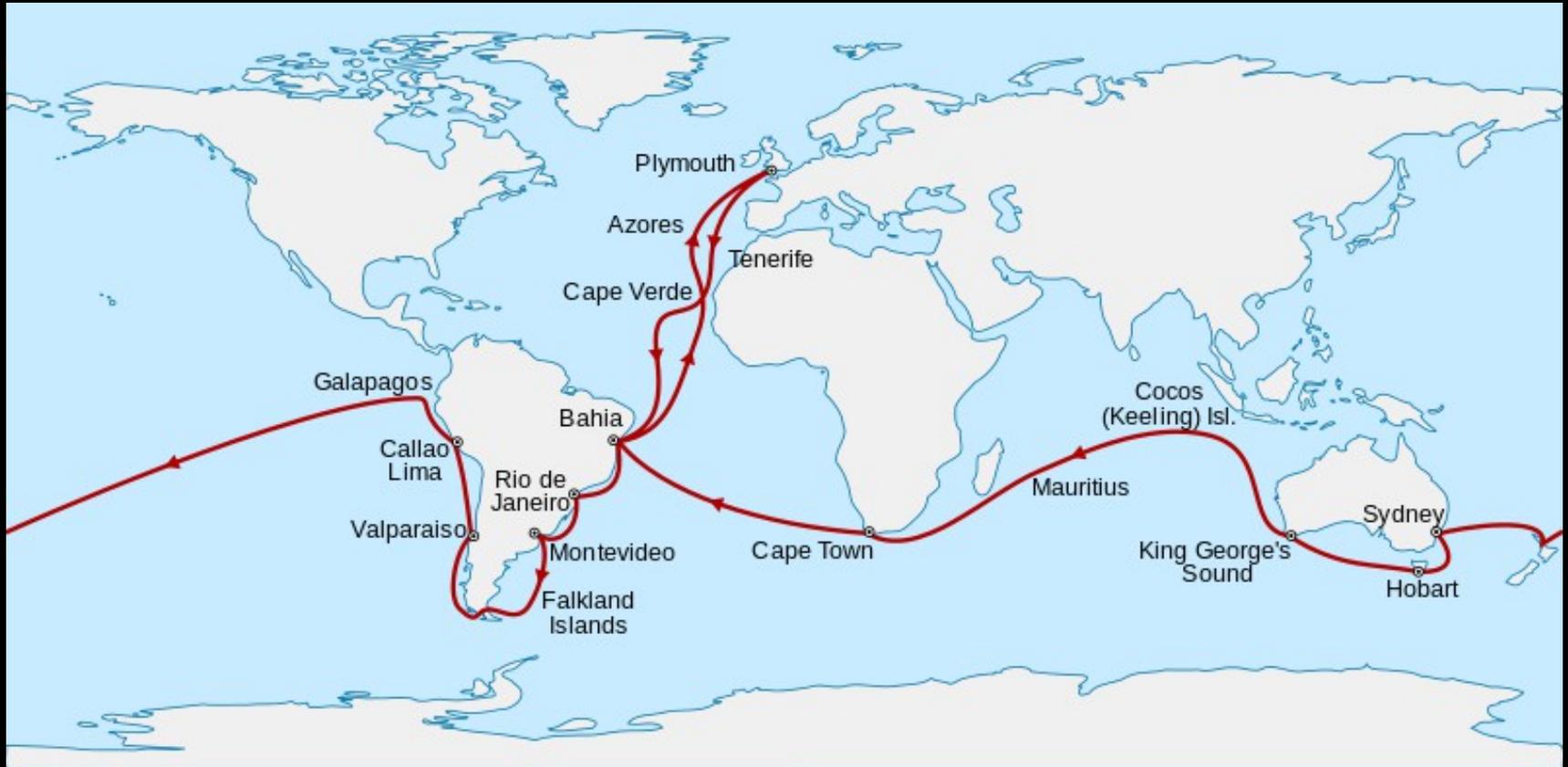
Charles Darwin

Sailed around the world
in the 1830's - many
observations

1859 published *Origins
of Species*, which
contained theory of
evolution by natural
selection.



Think Like Darwin Activity



Questions We Will Answer in this Unit

Is evolution
"just a theory"?

How do organisms
change over time?

Did humans evolve from chimpanzees?

How did all life we
see on earth today get here?

Why do some species
resemble one another?

Do organisms
choose to change?

Evolution

Process by which Genetic
Changes occur within a population
over many generations!



Are the changes that a frog undergoes an example of evolution?



Look at the definition of evolution, and apply the criteria before answering

Natural Selection is the theory of how evolution occurs.



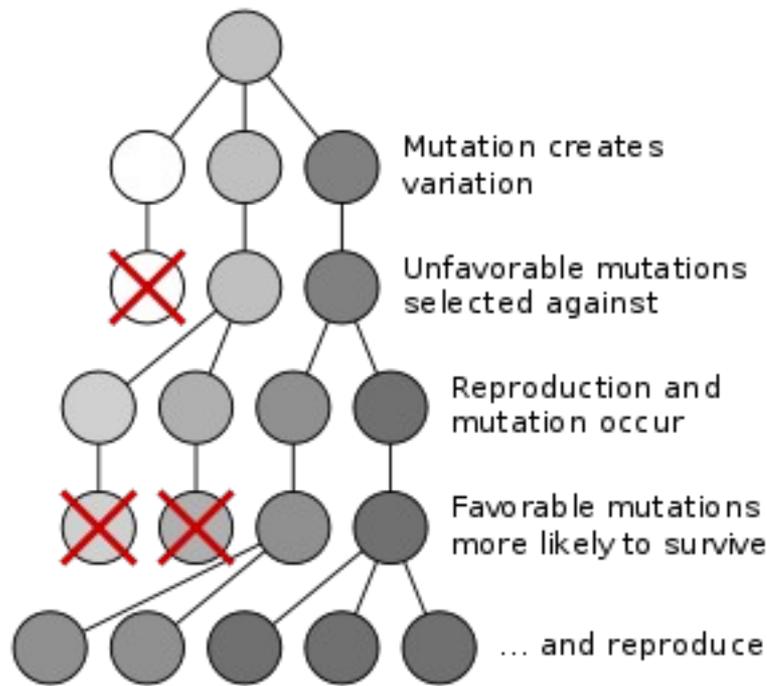
Definition:

The conditions in the environment determine which traits will make an individual more likely to survive



@JohnnyJet





Microevolution

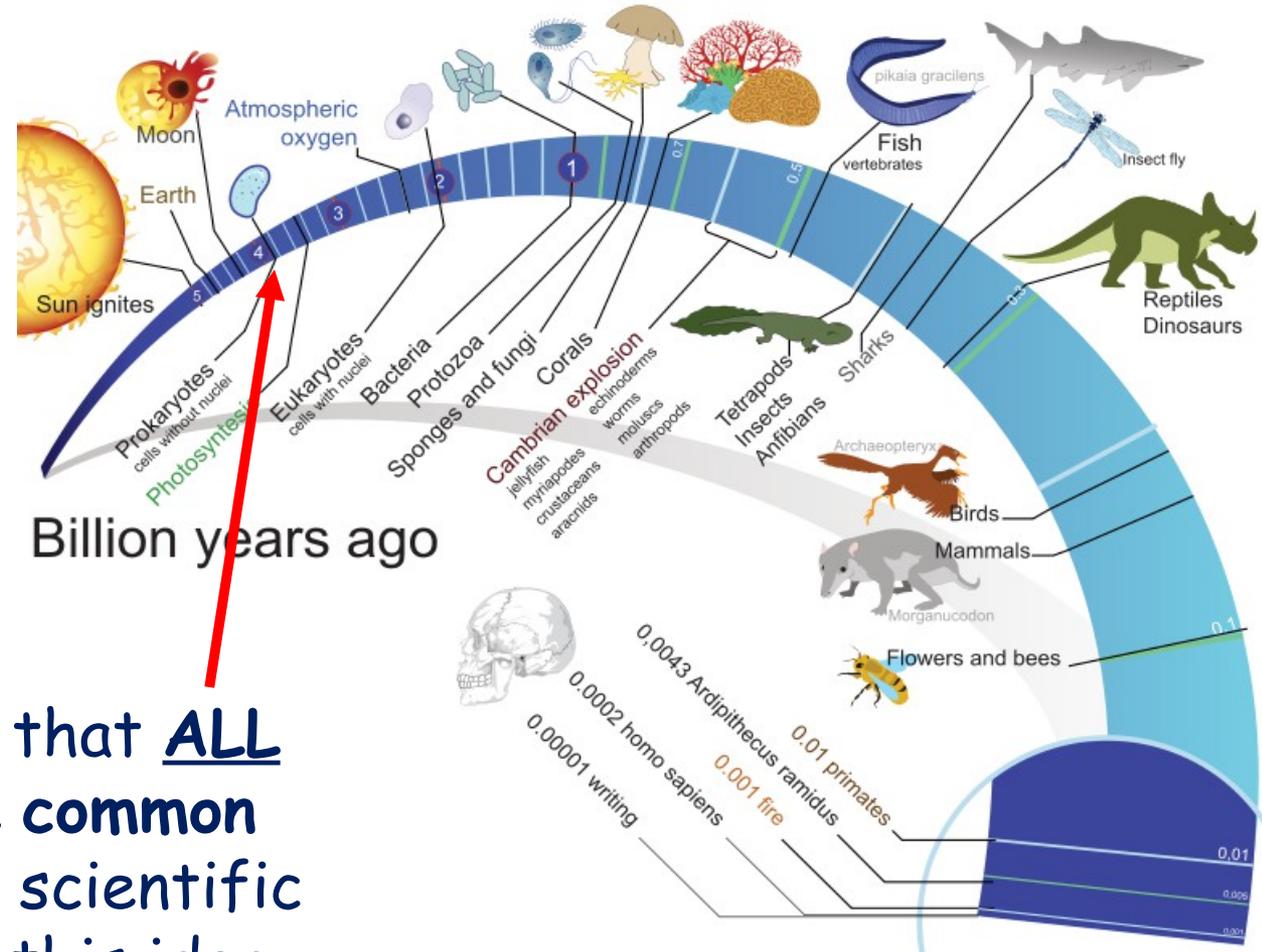
Process by which natural selection leads to the change in popularity of a gene within a population.



For example: Longer bills become very popular among hummingbirds in a forest of long flowers

Macroevolution

Process by which entire populations become new species. Studies history of all organisms and their evolution relationship to one another.



Darwin proposed that **ALL** organisms share **common ancestor**: All the scientific data agrees with this idea.

Earliest fossil is ~ 3.5 BYO
(Billion Years Ago)

What is an adaptation?

A trait that improves an organism's ability to survive and reproduce. They arise through random DNA mutation

Structural: Birds have hollow bones for easier flight

Physiological: Venom produced by snakes to kill prey

Behavioral: stick bugs sway while they walk - predators they are twigs in the wind



There are four requirements in order for natural selection to occur:

Genetic Variation within a population

Overproduction of offspring

Struggle for existence

Differential survival and reproduction



Discussion Question:

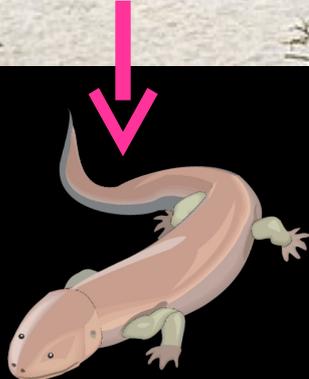
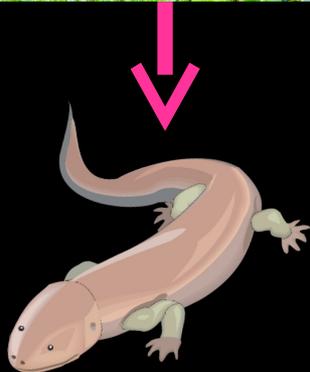
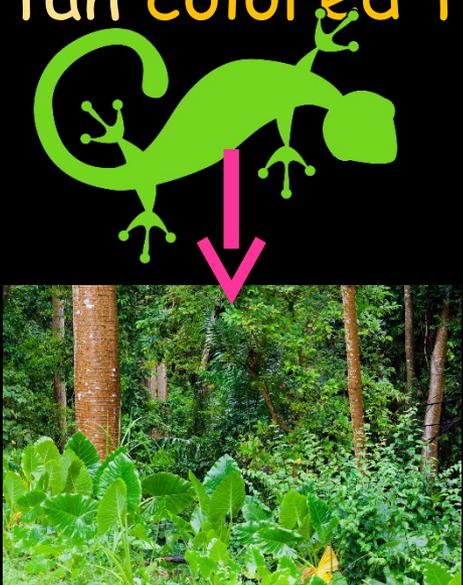


How do you feel when I tell you that a lab in China is working on engineering the perfect "superbug"; a bacterial strain that can't be killed by any of our current medications?



What are the 0.1% that are not killed?

Do Now: Half of a group of green lizards migrate from the lush, green, jungle, to a tan, beach area. TRUE or FALSE: The lizards that moved to the beach have a higher chance of getting mutations to become tan colored than the group in the jungle. Explain.



Speciation: A Colorful Analogy

We all can agree (save for the severely color blind) that this text is red.

We can also similarly agree that this text is blue.

If we have red text and decide to change it by just a small amount, the change might be barely noticeable, but still a very small change. This, we will call our micro-evolution. Every word up to now can be considered red, with very minute changes in the hue. If I keep typing long enough, would anyone be able to tell me, just by looking, at which word or letter is this post no longer red, but actually purple or blue? All this micro-evolution keeps occurring in the text, with it's tiny changes in hue, but ultimately, I end up with a completely different color. It's actually the difference between what one would consider red and what one would consider purple (or a whole new species, in this analogy) which is macro-evolution. See, the common misunderstanding is, that macro-evolution means a dog being a direct offspring of some other different canine-like species, or even more stupidly, a cat coming from a dog. Well, that's not what macro-evolution is. There is really only one distinction between micro-evolution and macro-evolution, and it's the same distinction between their prefixes: micro and macro. Just like if something is microscopic or if something is macroscopic. Microscopic usually requires a microscope to see it because it's so small, but the macroscopic are things large enough to be seen by the common human eye. However, things of both size are completely visible and plainly exist, and there are many things in this universe between both general sizes. So as you read this, can you tell me the first word here that is blue, and not purple? After all, every change in color since the first word in this paragraph has only micro-evolved from the color next to it, but we've managed to macro-evolve through 2 colors. This, hopefully, will illustrate how it's illogical to believe that macro-evolution doesn't happen, even given time for enough micro-evolution to occur.

So tell me -- what was the first purple word in the block of text above? What's the first blue word? Remember, if macro-evolution simply can not happen then you're saying the words you are reading now are still red.

Do Now: Review the 4 Components of Darwin's Theory of Natural Selection, and then decide if the following populations could evolve:

A population of clams that are all clones (genetically identical to one another)

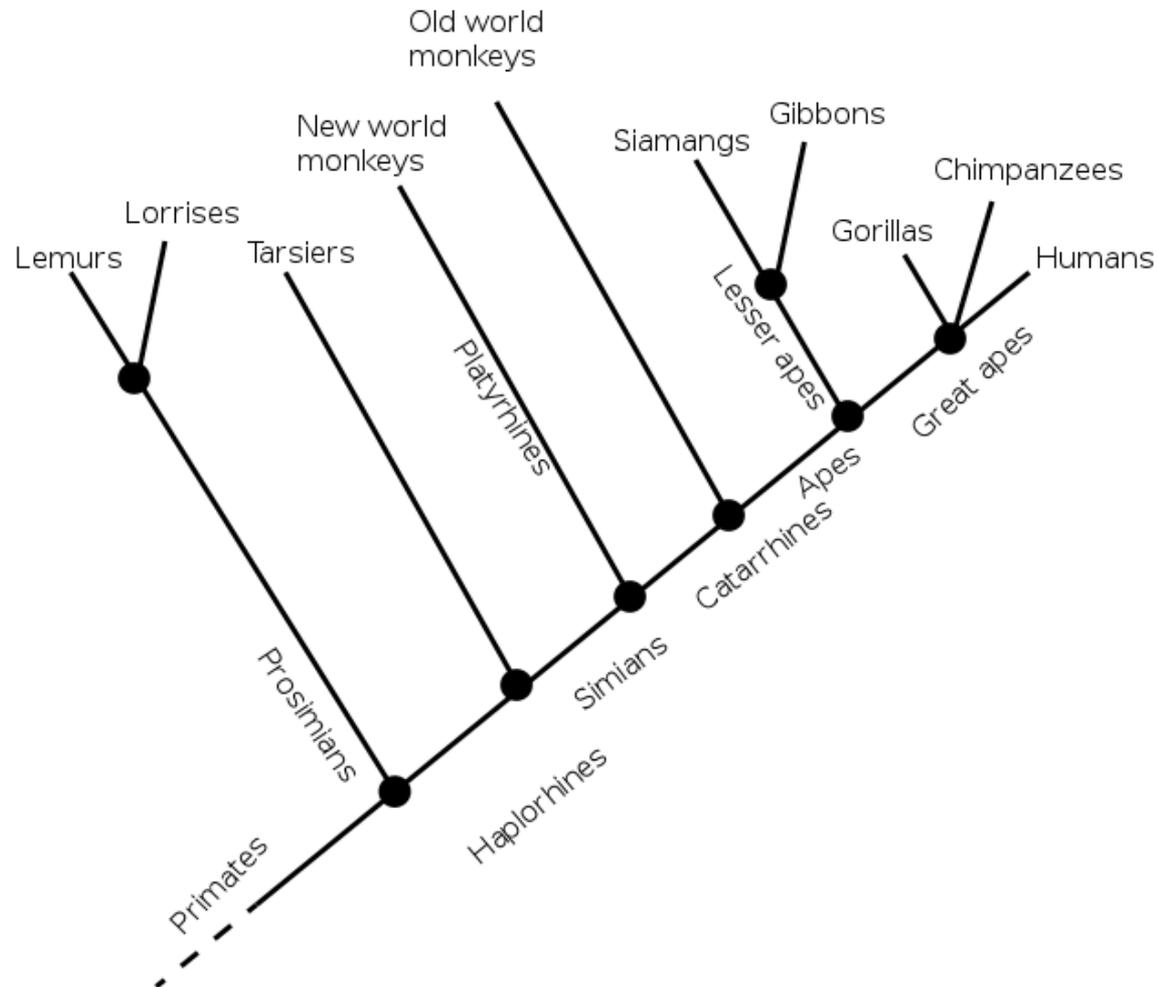
A population of all male tree frogs

C. a population of ten cave salamanders



Journal Question:

Did humans *evolve from chimpanzees*? Support your answer using the cladogram below.



Journal Question:

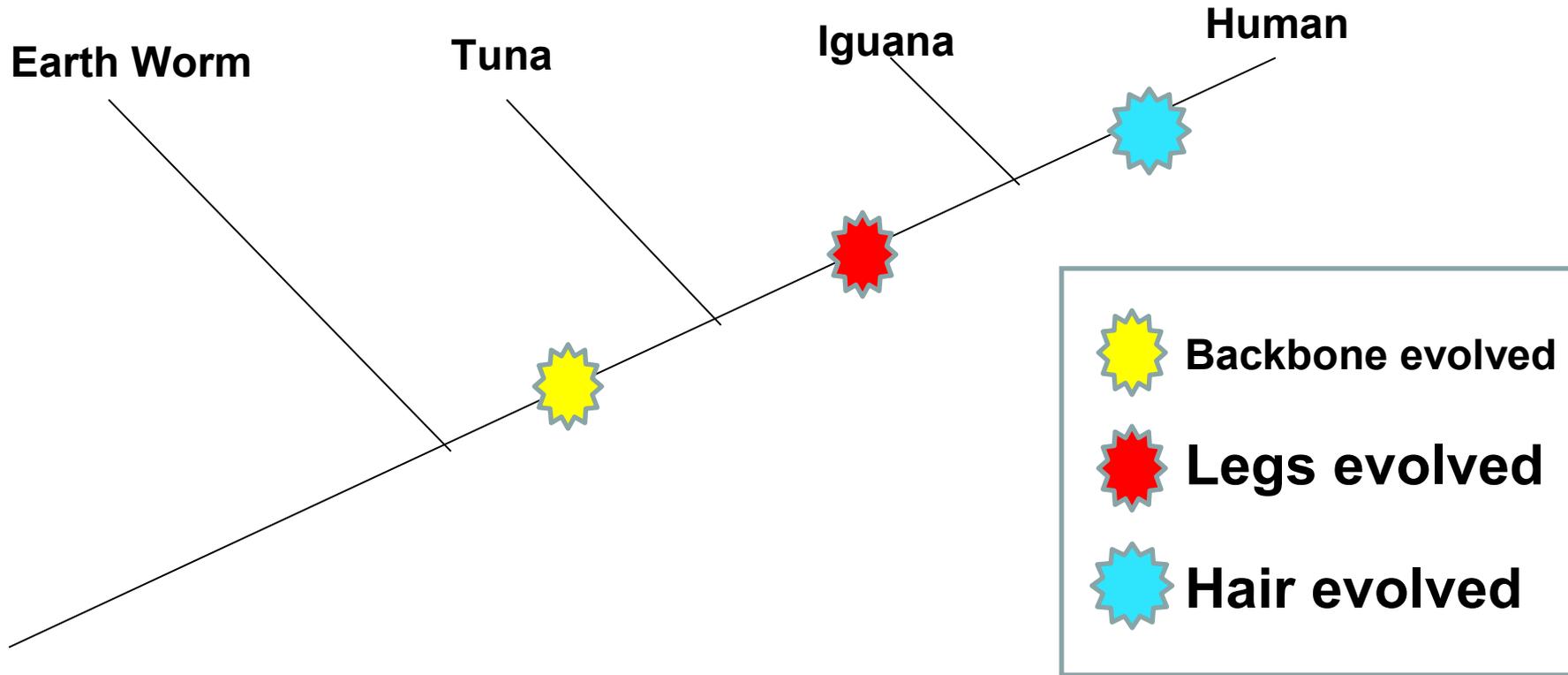
Use the chart below to construct a cladogram for the four organisms listed.

Then, place each characteristic on the correct spot of your cladogram.

	Backbone	Legs	Hair/Fur
Tuna	+	0	0
Iguana	+	+	0
Earth worm	0	0	0
Human	+	+	+

Journal Question:

	Backbone	Legs	Hair/Fur
Tuna	+	O	O
Iguana	+	+	O
Earth worm	O	O	O
Human	+	+	+



Journal Question:

Use the chart below to construct a cladogram for the four organisms listed.

Then, place each characteristic on the correct spot of your cladogram.

	Cells	Shell	reptile	mammal	tusks	Walks on 2 legs
Turtle	+	+	+	○	○	○
Human	+	○	○	+	○	+
Worm	+	○	○	○	○	○
Giraffe	+	○	○	+	○	○
Elephant	+	○	○	+	+	○
Lizard	+	○	+	○	○	○

Journal Question:

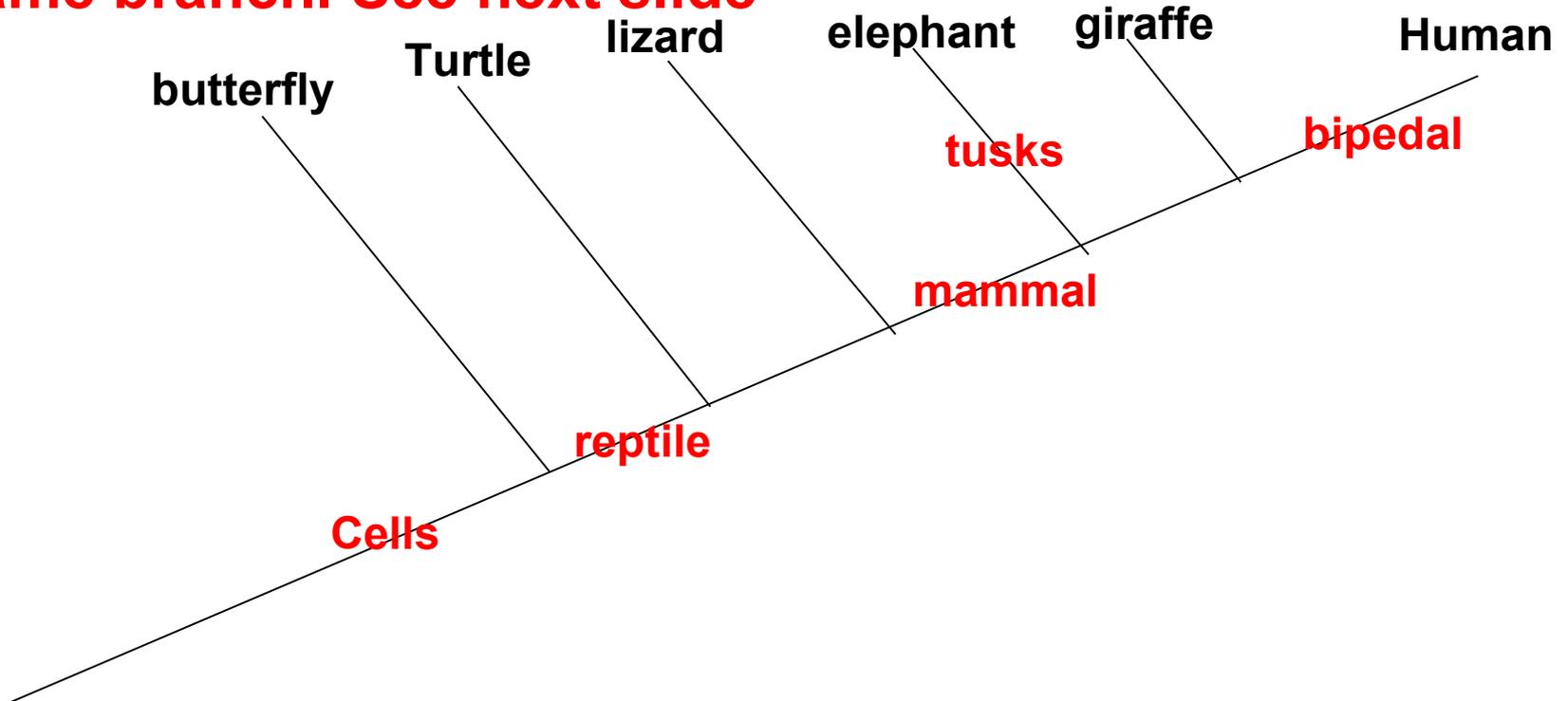
Do we have any info to say whether turtle or lizard comes first?

Answer:

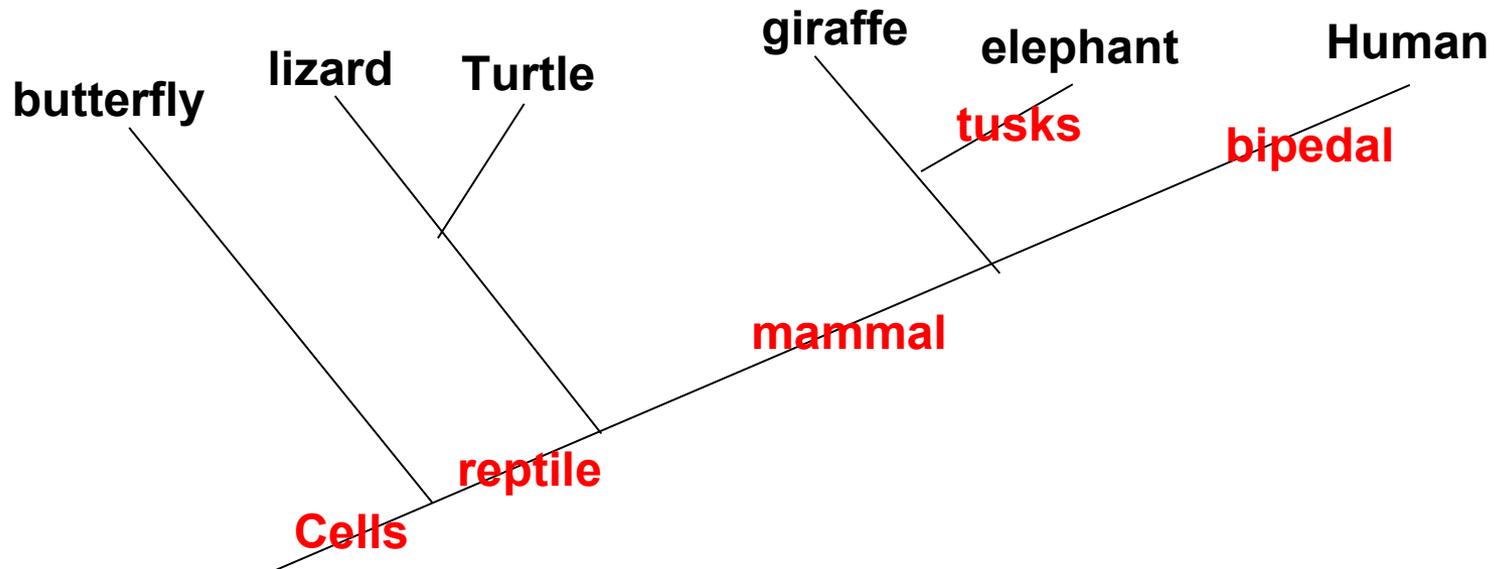
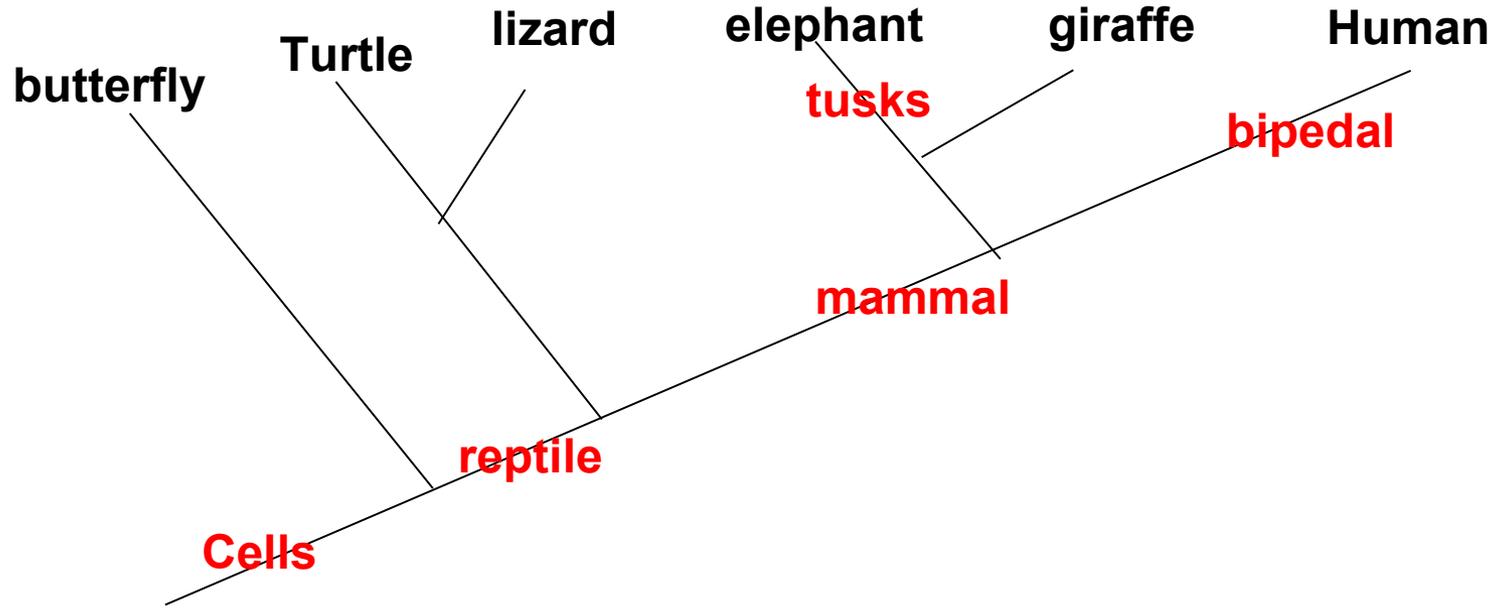
Answer: NO. Therefore, they can be placed on the same branch. See next slide.

Do we have any info to say elephant or giraffe comes first? T

Answer: NO. Therefore, they can be placed on the same branch. See next slide



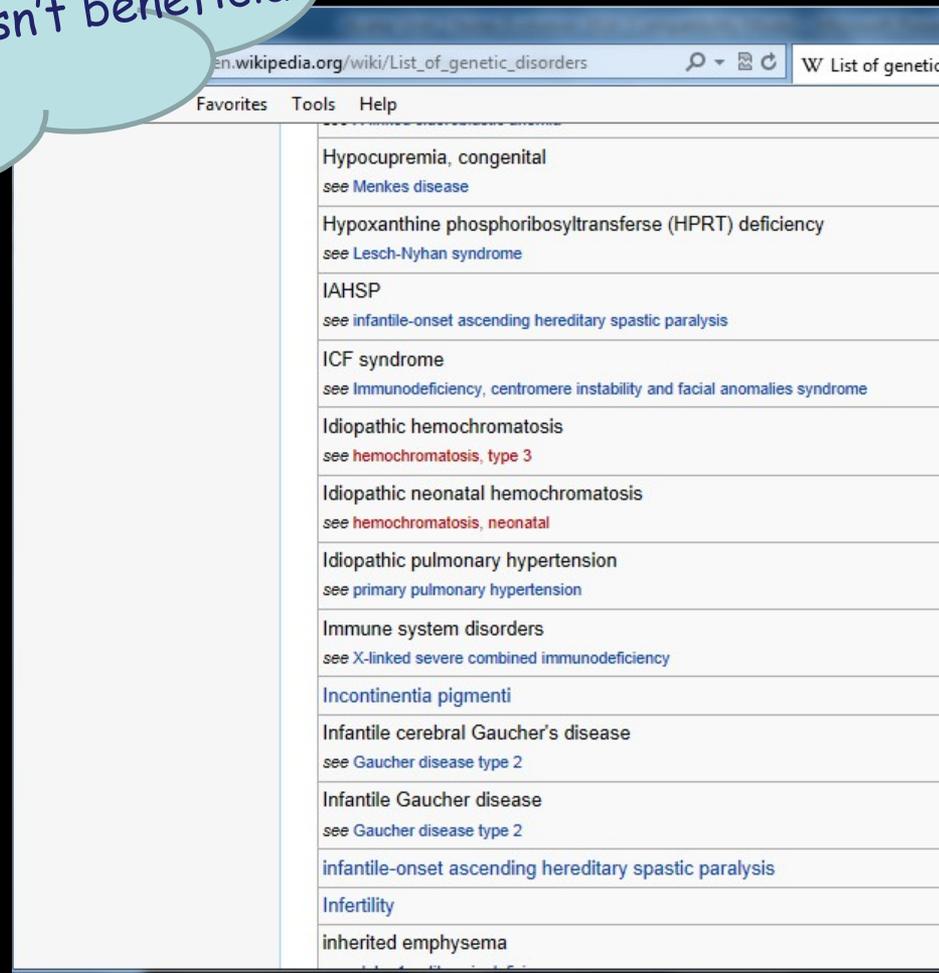
Both of these are interchangeable, and represent the same thing.
Remember, cladograms are hypotheses, and change as we get more
information



Does Evolution by Natural
Selection Produce Perfectly
Adapted Organisms?

Does Evolution by Natural Selection Lead to Perfectly Adapted Organisms?

Let's take a look at some of the random mutation that isn't beneficial in humans

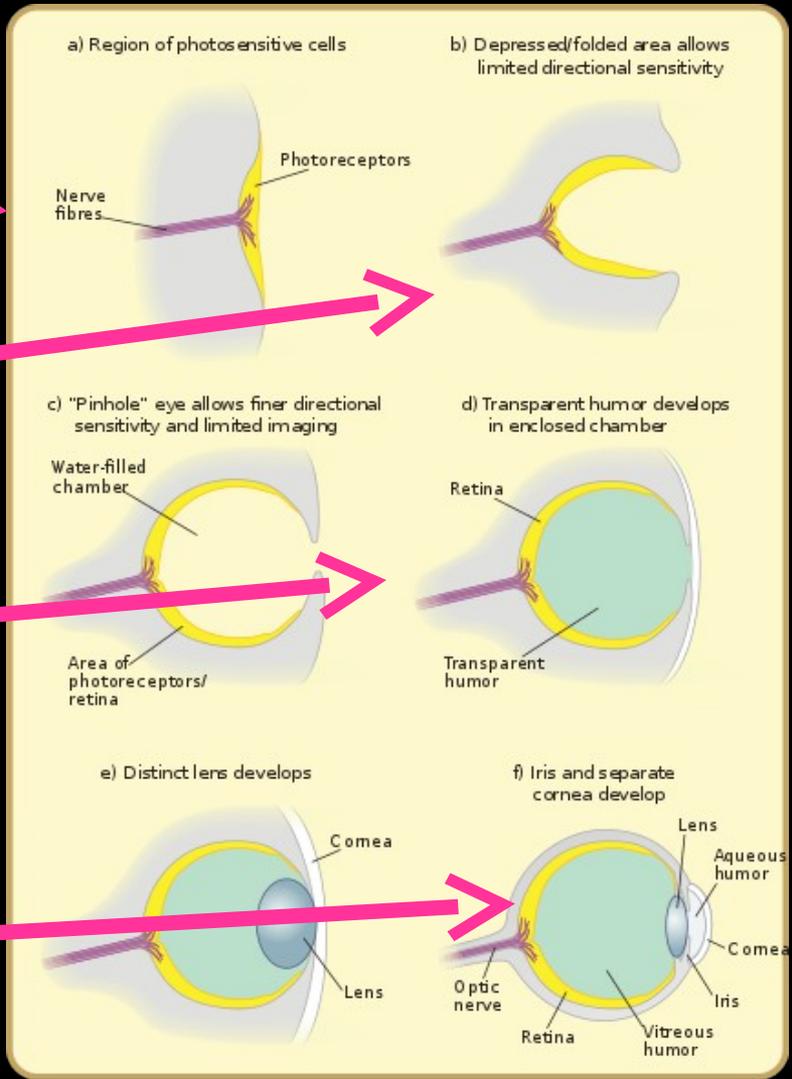


The screenshot shows a web browser window displaying the Wikipedia page 'List of genetic disorders'. The browser's address bar shows the URL 'en.wikipedia.org/wiki/List_of_genetic_disorders'. The page content is a list of genetic disorders, each with a brief description and a link to a more detailed article. The disorders listed include:

Hypocupremia, congenital	see Menkes disease
Hypoxanthine phosphoribosyltransferase (HPRT) deficiency	see Lesch-Nyhan syndrome
IAHSP	see infantile-onset ascending hereditary spastic paralysis
ICF syndrome	see Immunodeficiency, centromere instability and facial anomalies syndrome
Idiopathic hemochromatosis	see hemochromatosis, type 3
Idiopathic neonatal hemochromatosis	see hemochromatosis, neonatal
Idiopathic pulmonary hypertension	see primary pulmonary hypertension
Immune system disorders	see X-linked severe combined immunodeficiency
Incontinentia pigmenti	
Infantile cerebral Gaucher's disease	see Gaucher disease type 2
Infantile Gaucher disease	see Gaucher disease type 2
infantile-onset ascending hereditary spastic paralysis	
Infertility	
inherited emphysema	

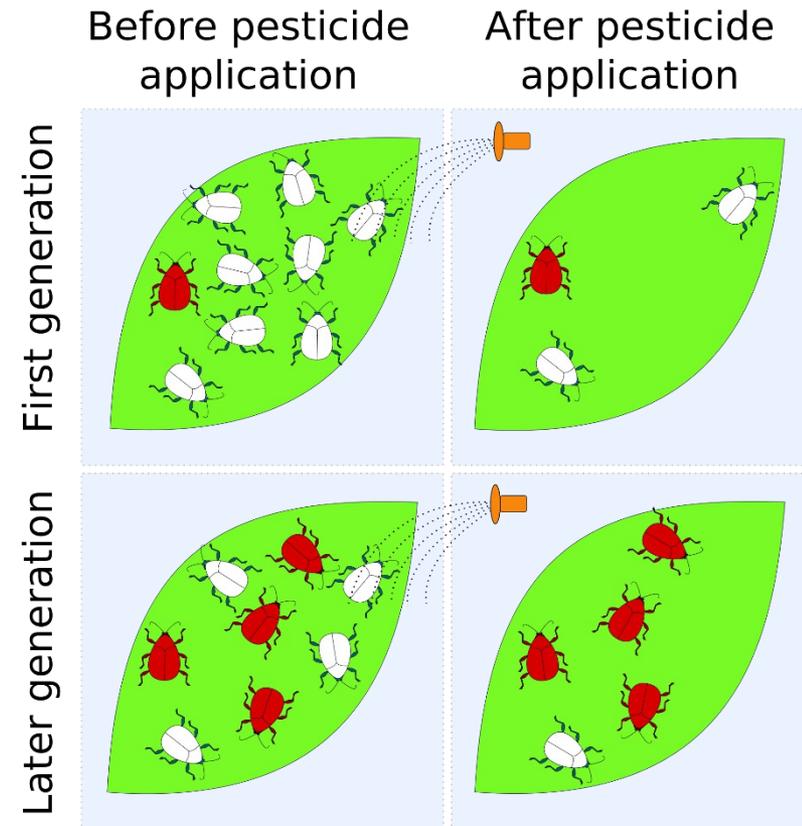
How can random accidents in DNA (mutations) produce something as complex as the human eye (for example)? Can natural selection really account for this? *(BTW...the human eye isn't a very good design)*

What the organism sees:



Why Does Evolution Matter Today?

1. Disease: *Antibiotic Resistance* - when bacteria evolve to not be killed by antibiotics - understanding how microbes evolve help us fight disease
2. Food: *Pesticide Resistance* - when pests evolve to not be killed by pesticide/insecticide. Understanding how this occurs help us to produce enough crops to feed humans.
3. Conserving Species: without an understanding of a species evolutionary past, we can't make informed decisions to help prevent extinction

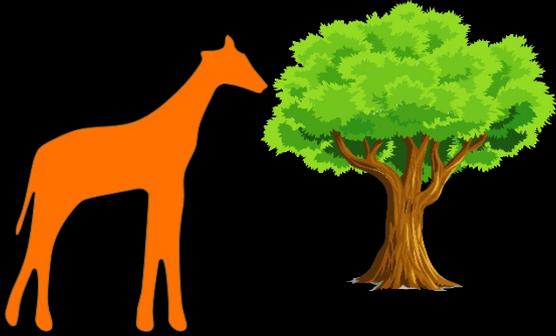


Artificial Selection:

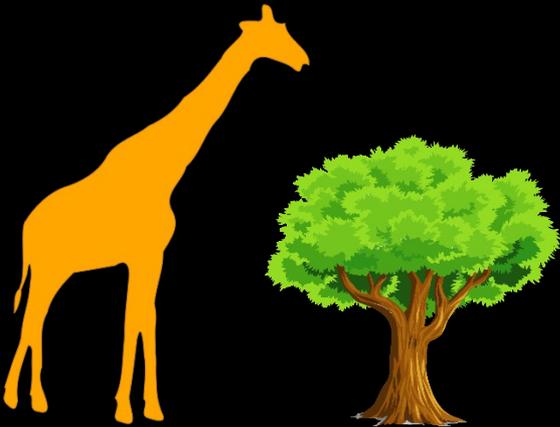
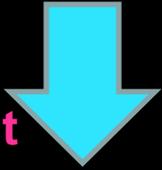
Artificial Selection: Humans have bred organisms with certain traits for thousands of years - have shaped the traits of many organisms over time
example: crops, dogs



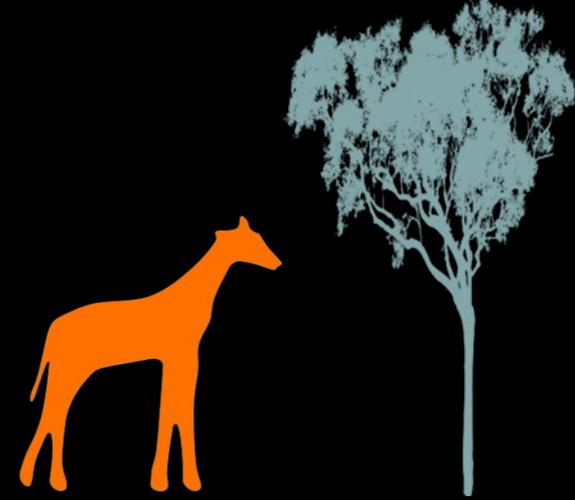
True or False; A population of short giraffes that migrates to an area with only tall trees are more likely to have their DNA mutate to cause longer necks than a population of giraffes who live in an area with shorter trees.



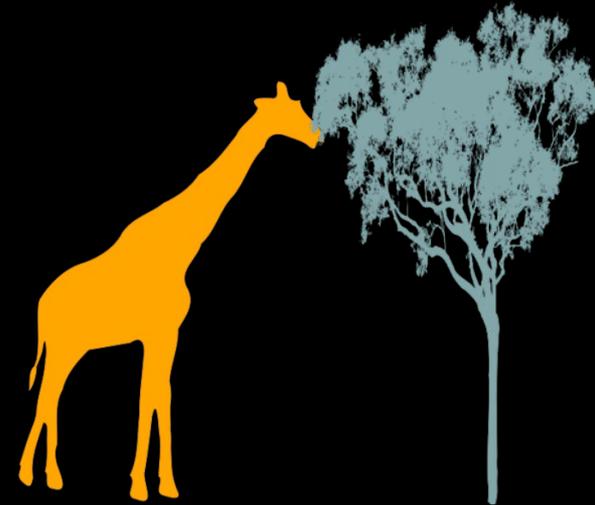
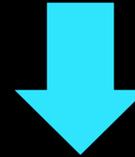
Short tree
Environment



VS.

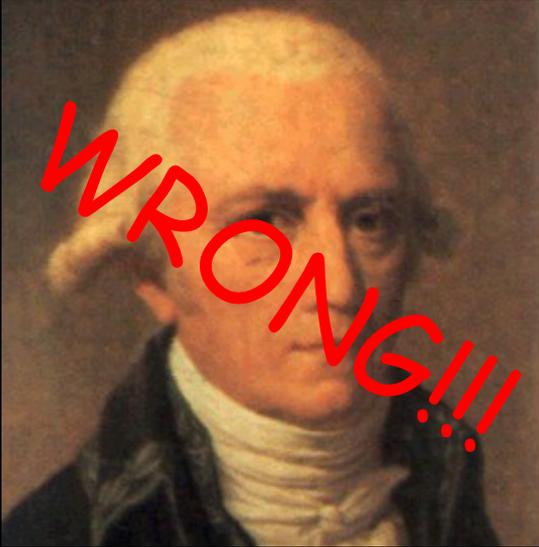


Tall tree
Environment



Jean-Baptiste Lamarck

Lamarck's hypothesis of "Inheritance of Acquired Traits"



Organisms acquire traits by using or not using them. Organisms are able to pass down any traits they acquire throughout their life. For example, giraffes worked to stretch their neck to reach tall leaves, which is why their offspring have long necks.

Can you think of other examples?

Journal Question:



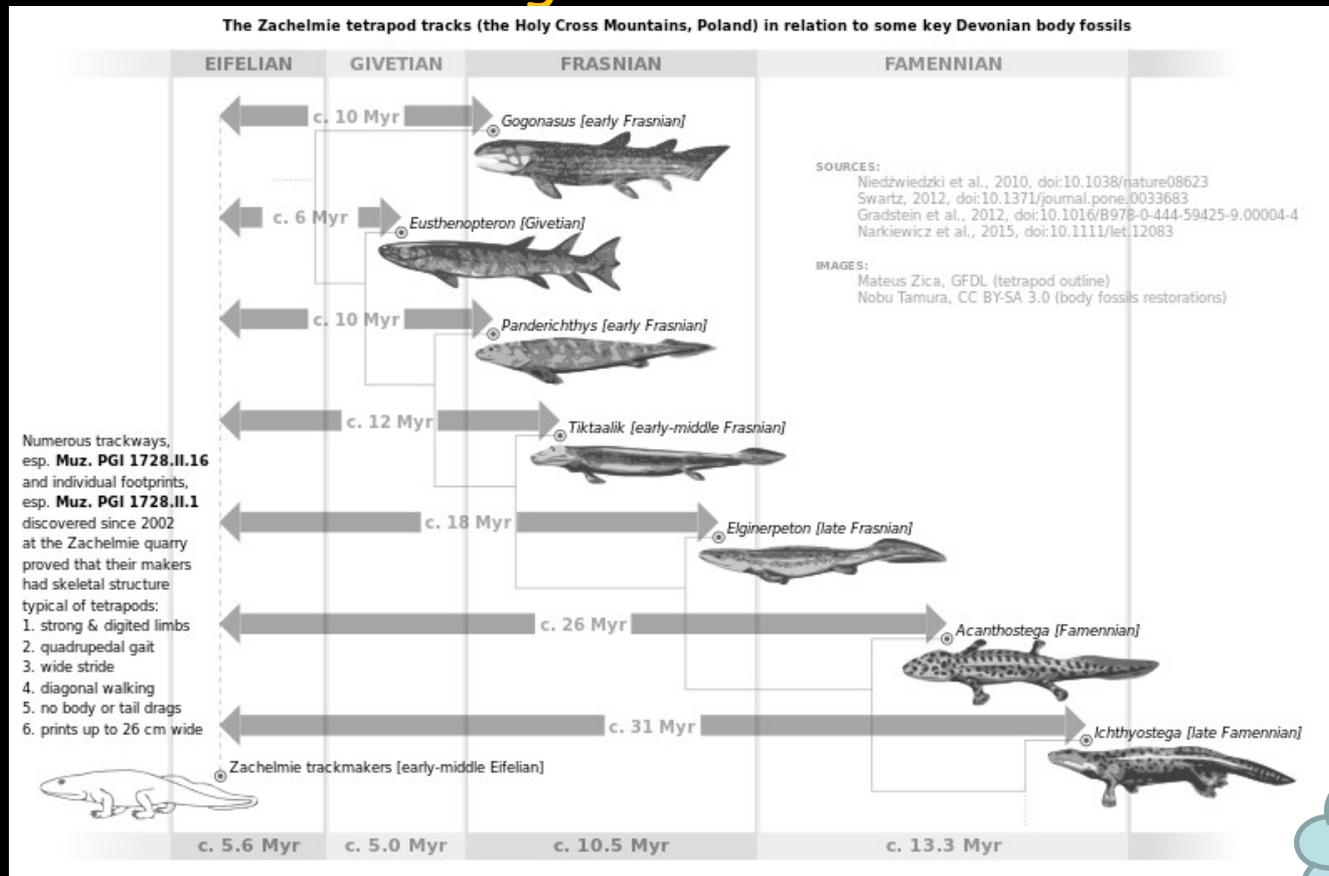
If Evolution by Natural Selection is just a "theory", then why should it be accepted over any other proposed ideas?

Scientific Theory: An explanation supported by large volumes of evidence through research/experimentation

Fossil Record

All fossil evidence, taken together, shows a detailed story of how many species have changed over eons

Radioactive dating (like carbon dating) help us calculate the age of fossils

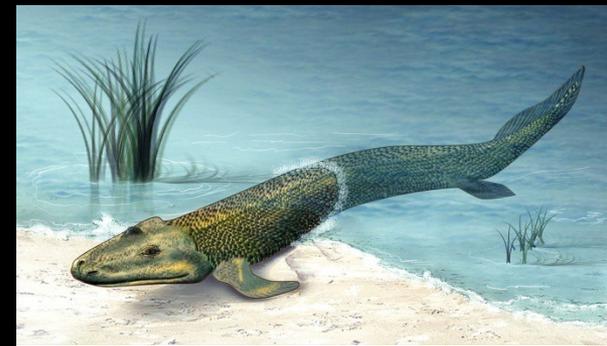


Link to Transitional fossils

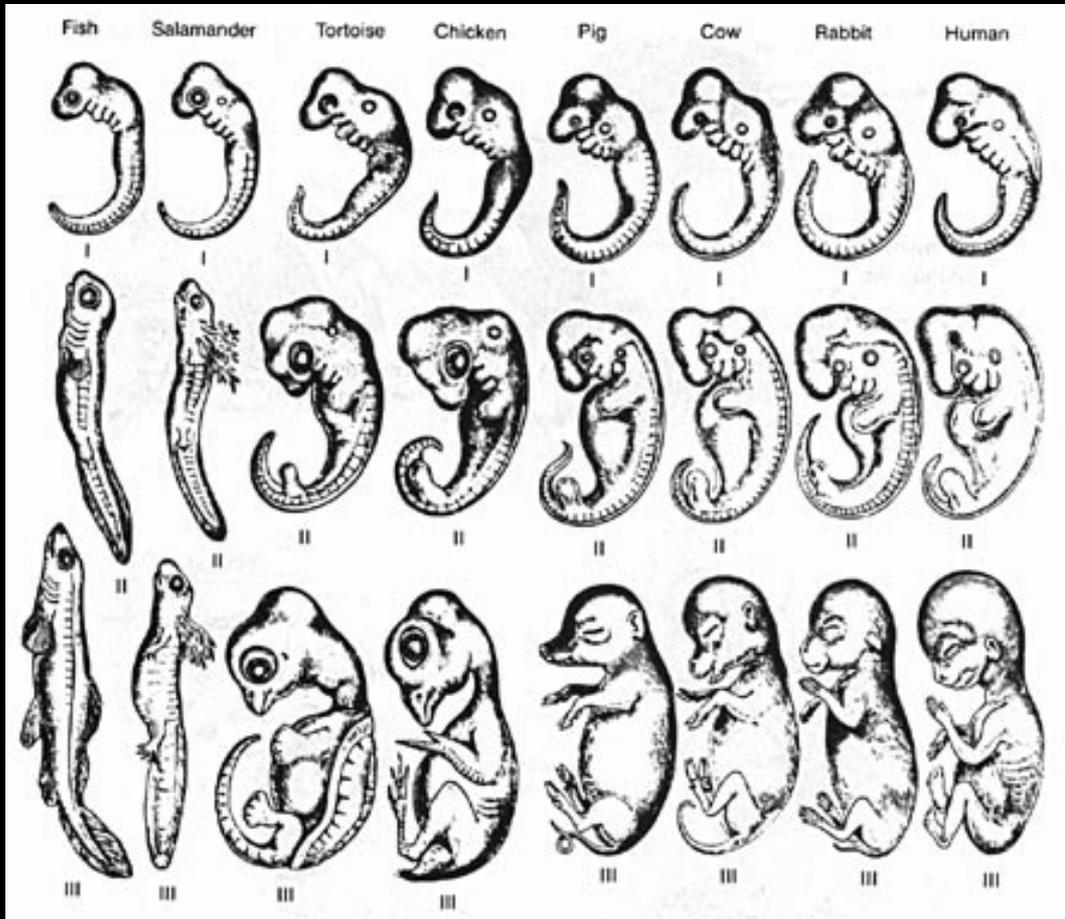
Fossil Record -Continued

Link!!

- Transitional fossil – fossil that shows characteristics of both ancestral group, and descendent species
- **Dinosaurs to birds – Archaeopteryx** 145 mya The famous *Archaeopteryx* had feathers and was probably capable of at least gliding, but it also had dinosaur-like teeth, claws, and a long bony tail. Its skeleton was "almost identical to that of some theropod dinosaurs
- **Fish to Land-dwellers – Tiktaalik** 375 mya Though still a water-dweller, *Tiktaalik* had fins that were halfway towards being feet, and ears capable of hearing in air or water (Prothero, 2007). It was capable of crawling around in very shallow water, and it had a neck, unlike fish but like tetrapods (Coyne, 2009).
- **Land Mammals to Whales/Dolphins – Rodhocetus** 45 mya The nostrils of *Rodhocetus* have started to move backwards (towards the blowhole position) and the skeleton indicates a much stronger swimmer (Coyne, 2009). On land it would struggle, moving "somewhat like a modern eared seal or sea lion" (Gingerich *et al*, 2001). Its teeth were simpler than its predecessors (Futuyma, 2005), a trend that continued to the present.)



Embryology

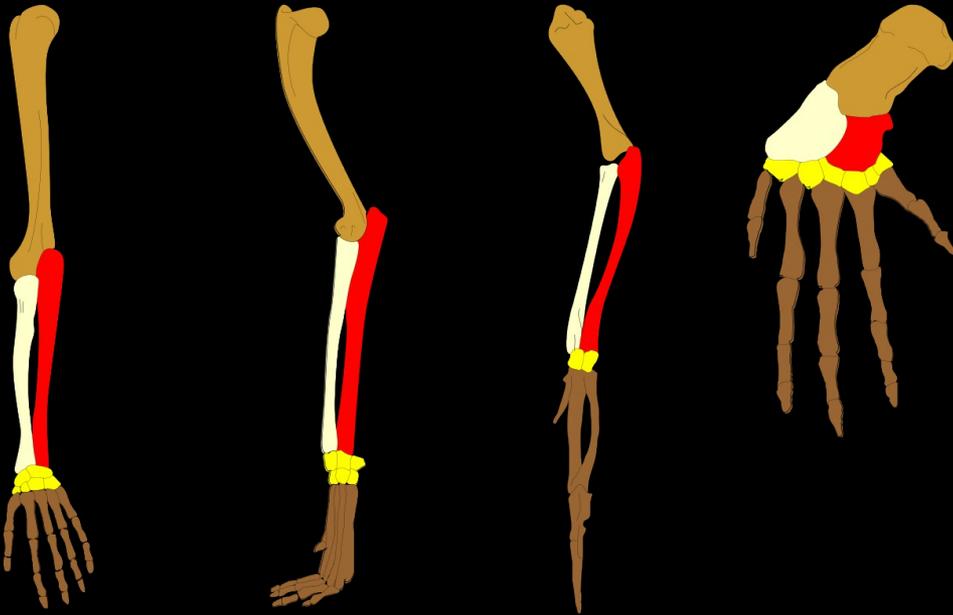


Vertebrate embryos show very similar pattern of development. Supporting theory that vertebrates evolved from common ancestor

Anatomy

1. *Homologous structures* - body parts that are arranged similarly in very diversely adapted organisms

-Therefore, evolved from common ancestor

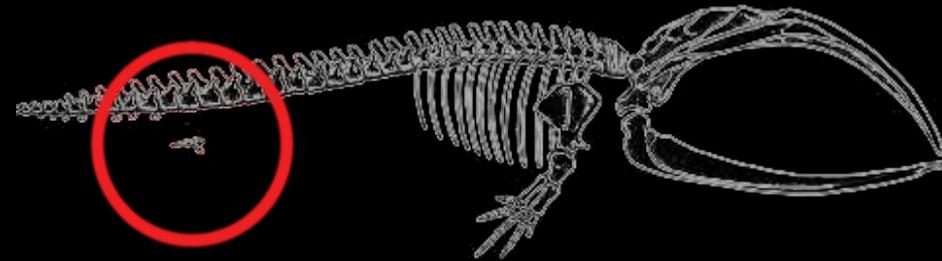


Anatomy

2. Vestigial structures



- Organs that are no longer used and reduced in size
- Examples: Appendix, tail bone (coccyx), muscles of the ears, ostrich wings, wisdom teeth, "chills", whale's pelvis, eyes in cave organisms
- Left over from ancestor species



Jaw-dropping theory of human evolution

Did mankind trade chewing power for a bigger brain?

Michael Hopkin



A big jaw in chimps (top) could preclude the evolution of a large brain, as in humans (bottom).

© SPL

Researchers have proposed an answer to the vexing question of how the human brain grew so big. We may owe our superior intelligence to weak jaw muscles, they suggest.

A mutation 2.4 million years ago could have left us unable to produce one of the main proteins in primate jaw muscles, the team reports in this week's *Nature*¹. Lacking the constraints of a bulky chewing apparatus, the human skull may have been free to grow, the researchers say.

The timing of the mutation is consistent with rampant brain growth seen in human fossils from around 2 million years ago, says Nancy Minugh-

Purvis of the University of Pennsylvania in Philadelphia, who helped with the study. "Right at the point you lose power in these muscles, brain size evolution accelerates," she says.

Chewing it over

The story hinges on a protein called MYH16, a chief component of the powerful jaw muscles of many non-human primates such as chimpanzees and gorillas. When the researchers examined human DNA samples from across the world, they discovered that we all share a defect in the gene that creates this protein. Using estimates of evolution rates, they deduced the mutation's age.

The researchers then compared human skulls to those of other primates, and saw that even distantly related species, such as gorillas and macaques, share large crests on their skulls to which their heavy jaw muscles attach. Such structures are notably absent from human skulls despite our fairly close genetic kinship with gorillas.

A mutation 2.4 million years ago could have left us unable to produce one of the main proteins in primate jaw muscles, the team reports in this week's *Nature*¹. Lacking the constraints of a bulky chewing apparatus, the human skull may have been free to grow, the researchers say.

Geographic evidence:



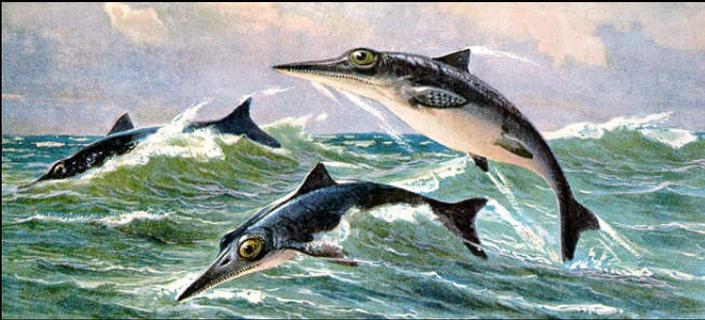
Divergent evolution - very closely related organisms have diverse adaptations because they have occupied different environments for many generations ex: bats, whales, kangaroos, and humans are all mammals

Convergent Evolution:

Distantly related organisms evolve similar adaptations because they live in very similar environmental conditions in the world



Shark - Fish



Ichthyosaur - Reptile



Dolphin - Mammal

Convergent Evolution:



Humming bird



Humming bird
moth



DNA/molecular Evidence

- All living things share the same basic DNA
- The more DNA in common, the more closely related 2 organisms are