

History of Life on Earth

We are on leading edge of the space time continuum

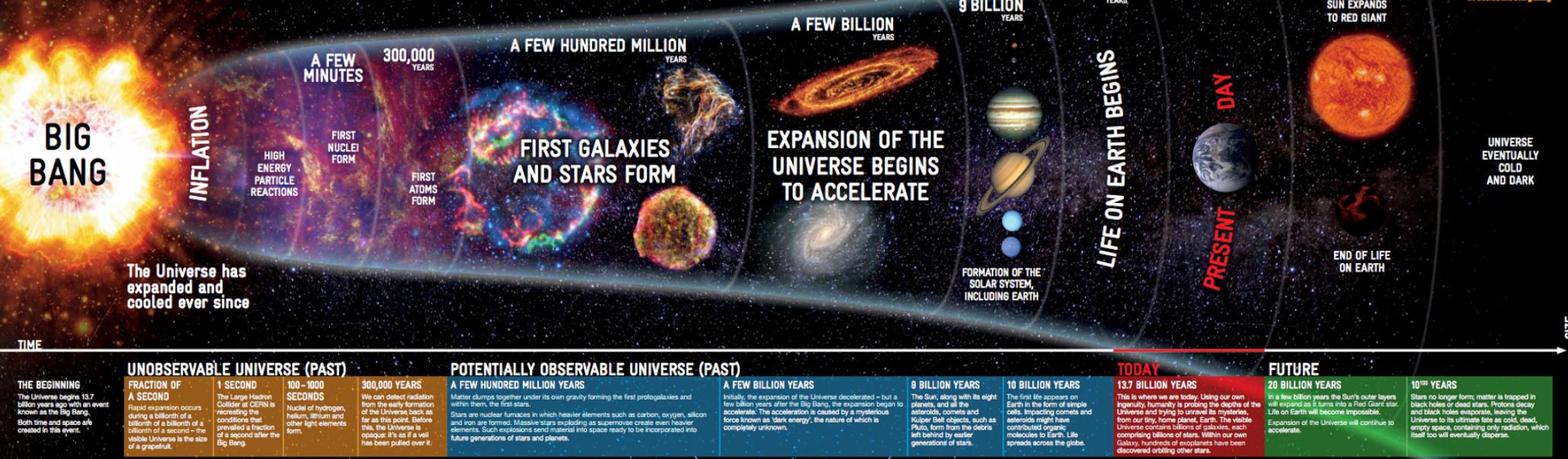
Past

Present

STARGAZING LIVE THE UNIVERSE THROUGH TIME

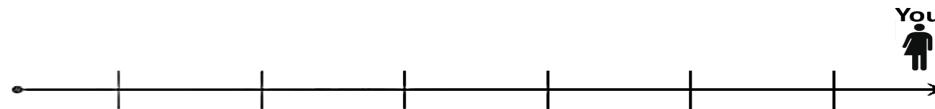


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Stargazing LIVE Star Guide
and find out more about
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How do you view the timeline of the history of life on Earth?

- Starts at early life?
 - where is that?



- Is your view biased towards human existence?

- What processes are key? Is tempo (time between events) important?

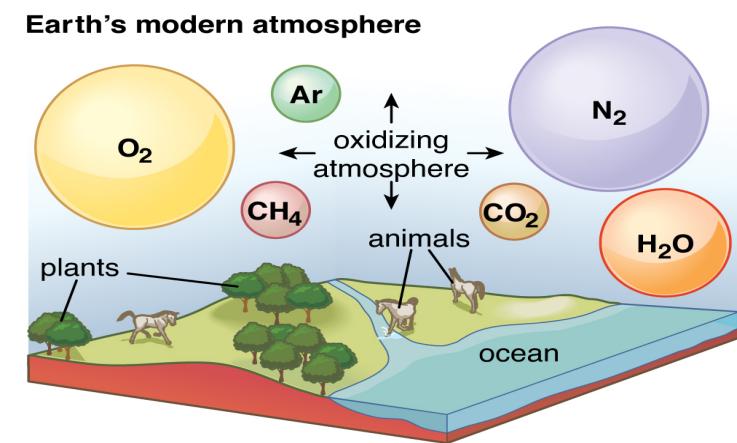
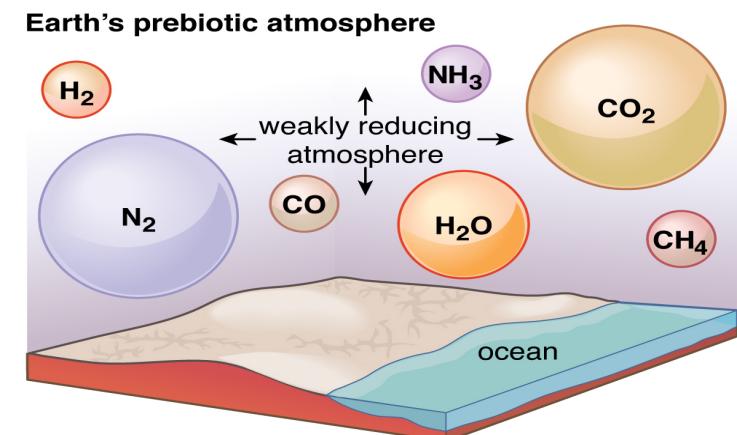
- Something non-science based?

- Perspective matters: Understanding the history of biodiversity and critical landmarks in life on Earth help us analyze current changes on Earth



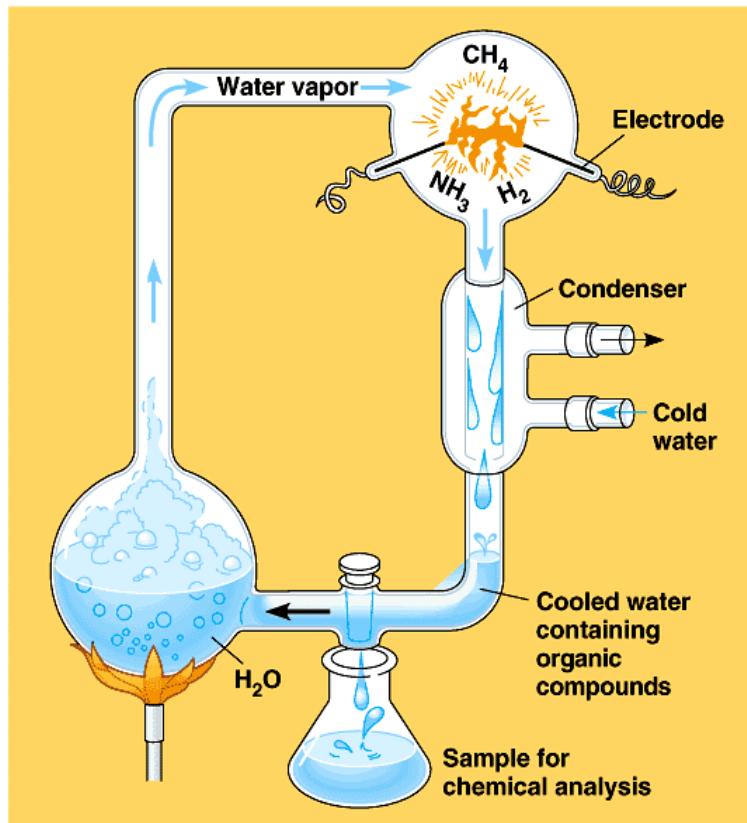
The Earth is old...and it took a while for life to form.

- Surface was way too hot to start
 - cooled enough to make a solid crust
 - cooled enough sustain liquid water
- An atmosphere needed to form
 - without an ozone layer, radiation from sun was too intense
 - oxygen needed to accumulate for animals
- Lots of inorganic molecules but few organic molecules
 - early atmosphere was reducing (oxidation prevented by absence of oxygen)
 - organic = compounds of carbon (basic building blocks of life)

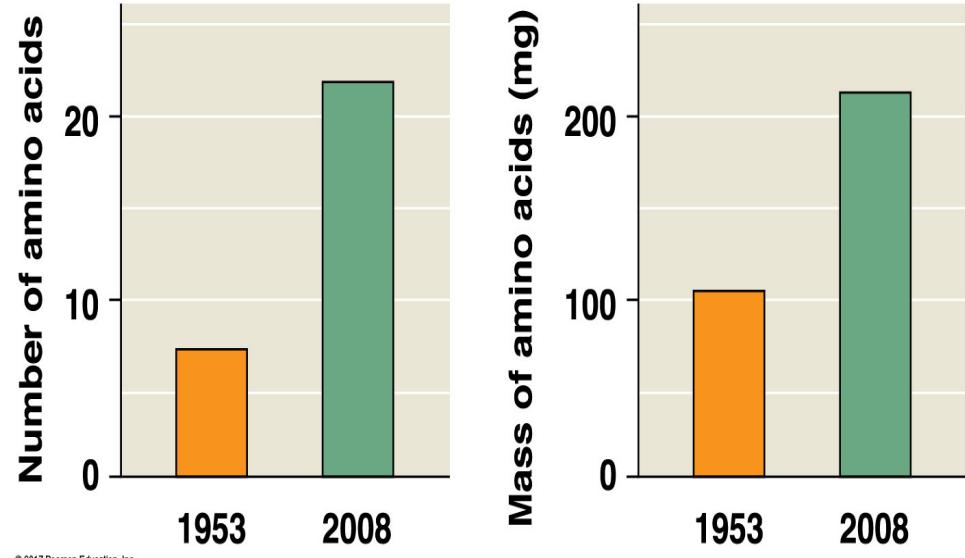
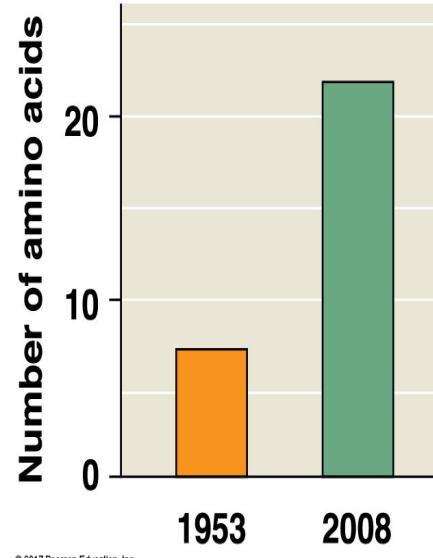


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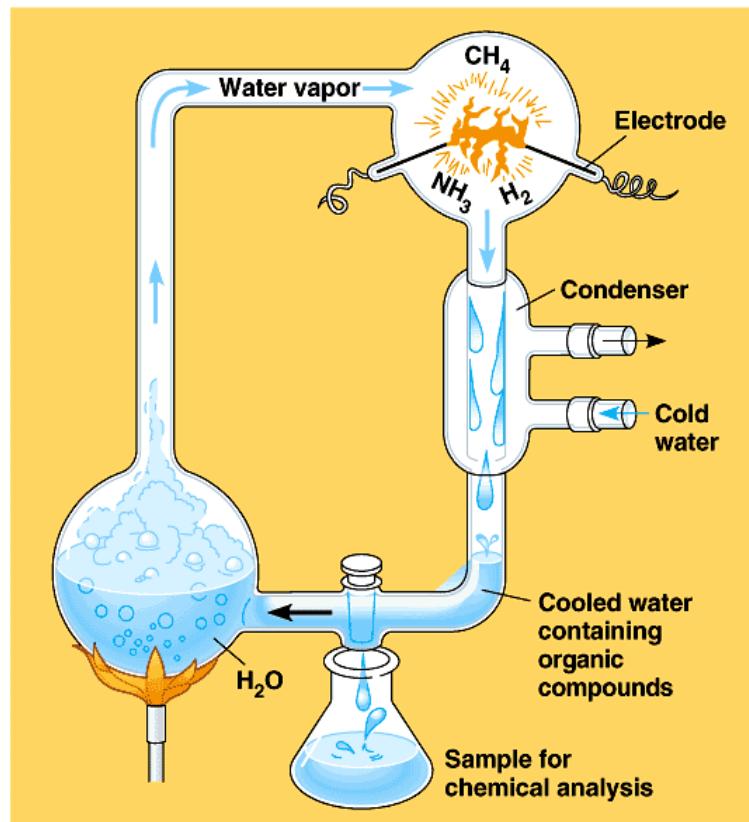
Miller & Urey experiments



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Miller & Urey experiments

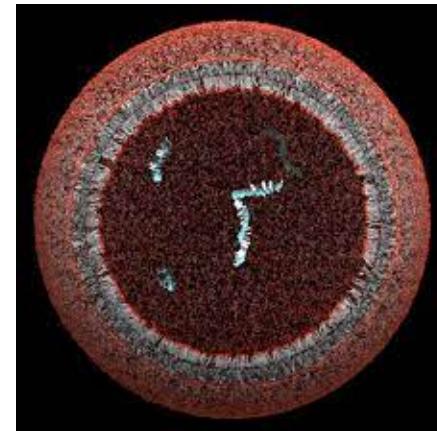


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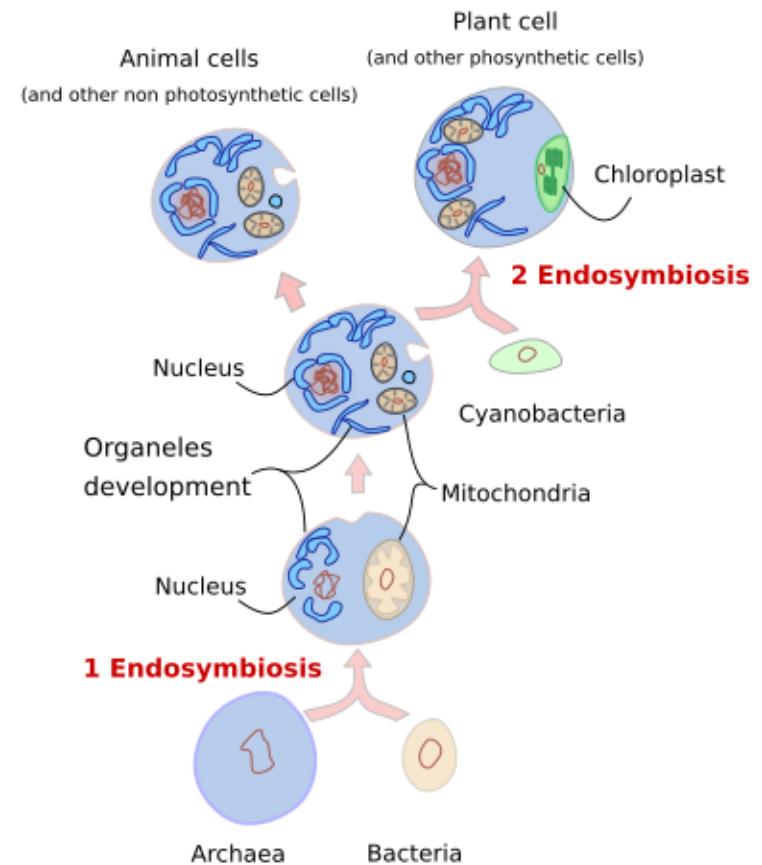
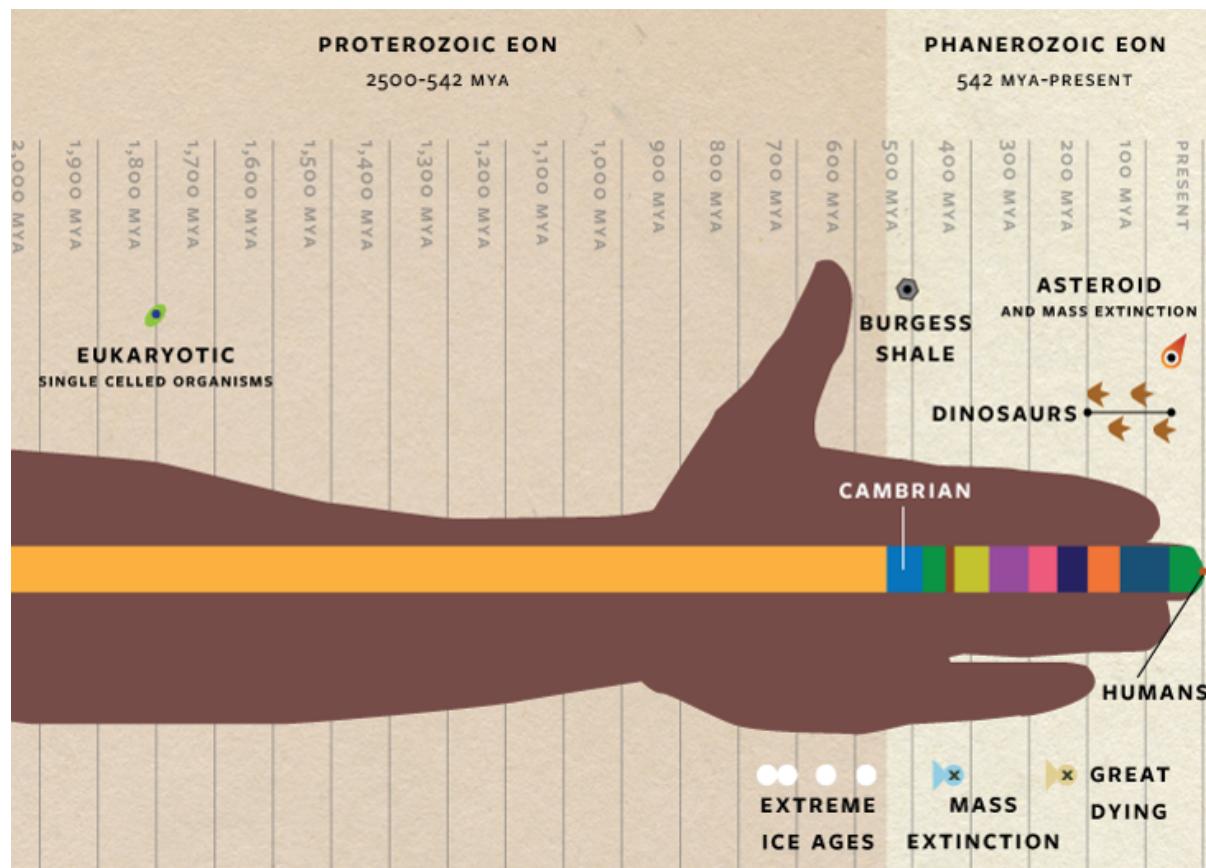


Origin of heredity was key for contemporary life

- RNA (molecule that could replicated itself) probably came first
 - ~3.8 billion years ago
- Somewhere between the formation of RNA and cellular life a mechanism to pass genetic information from parent to offspring emerged (heredity)
- Heredity is the key for evolution of life and biodiversity
 - replication → variation → competition → natural selection
 - mutations (replication mistakes) are the unit of variation
- Heredity likely took place in early 'protocells' with compartmentalized RNA
 - have not been re-created in the lab

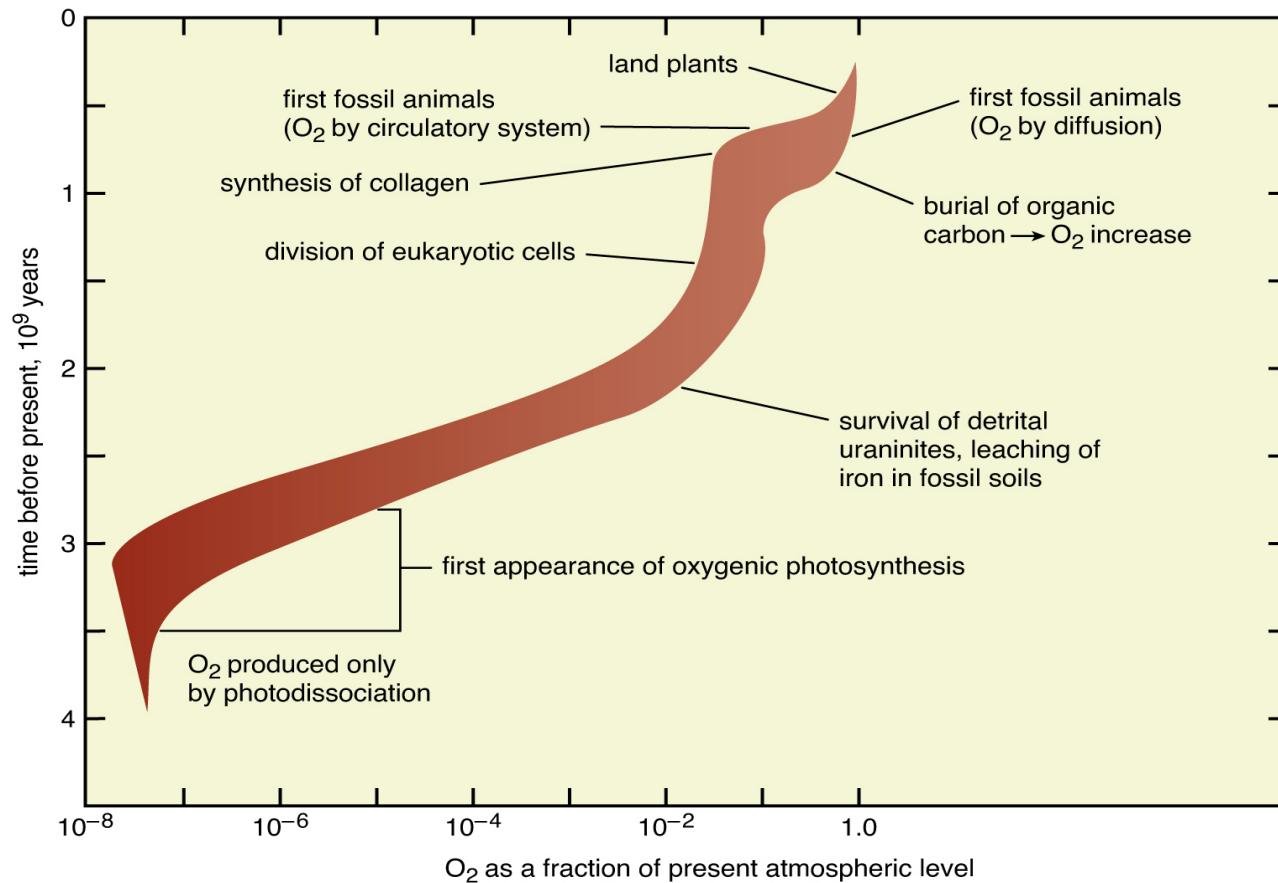


Cellular life begins ~3.5 billion years ago (key events)

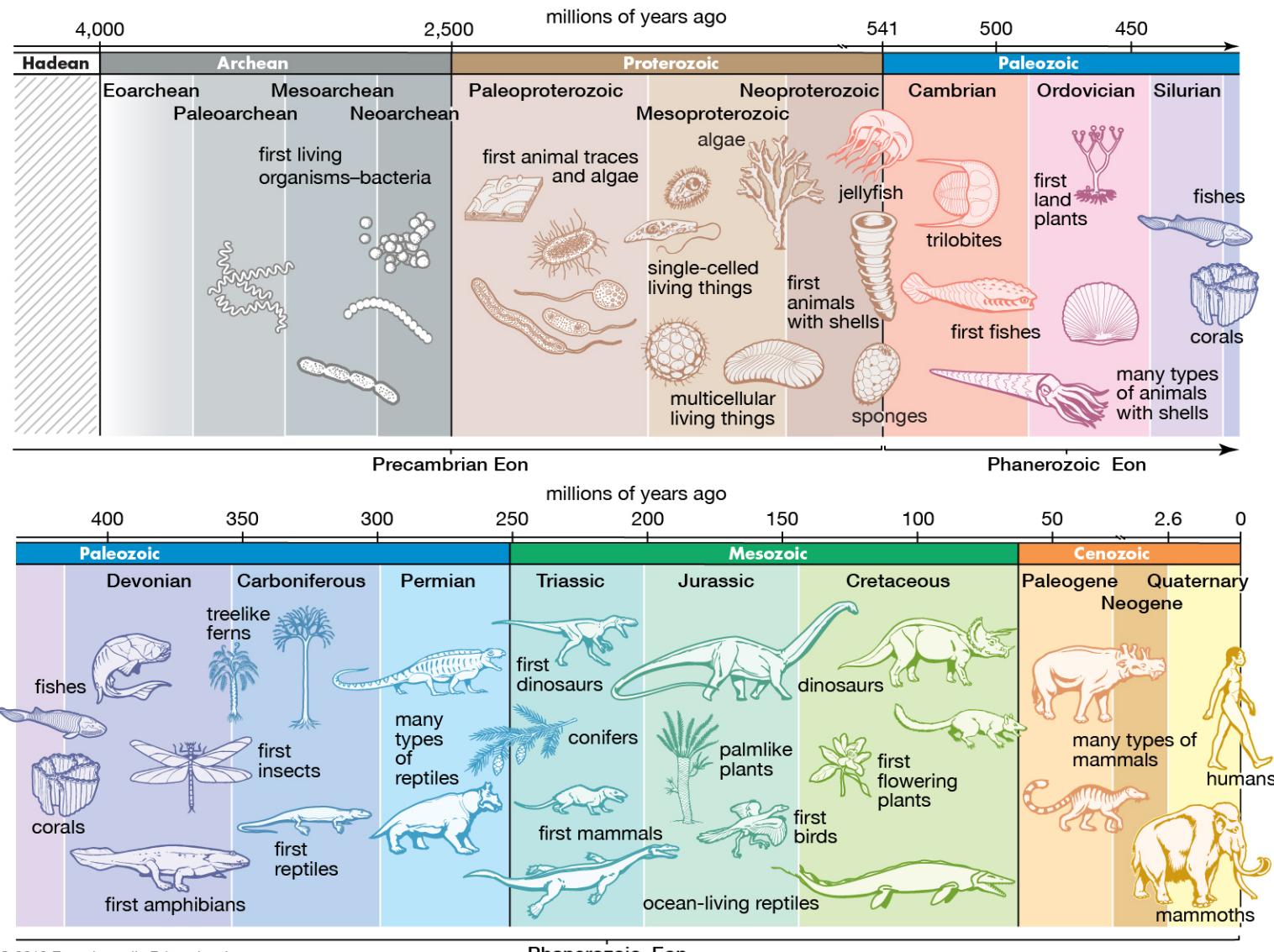


Single-celled organisms altered the evolutionary landscape

Changed atmosphere from negligible to 21% oxygen

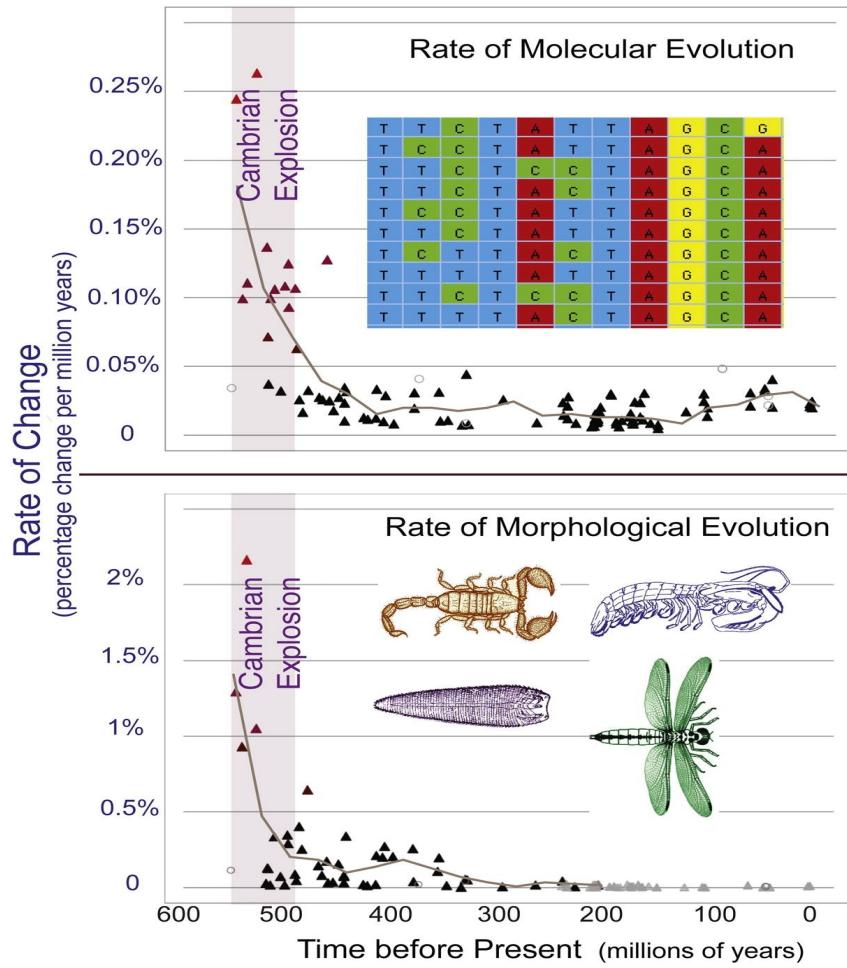


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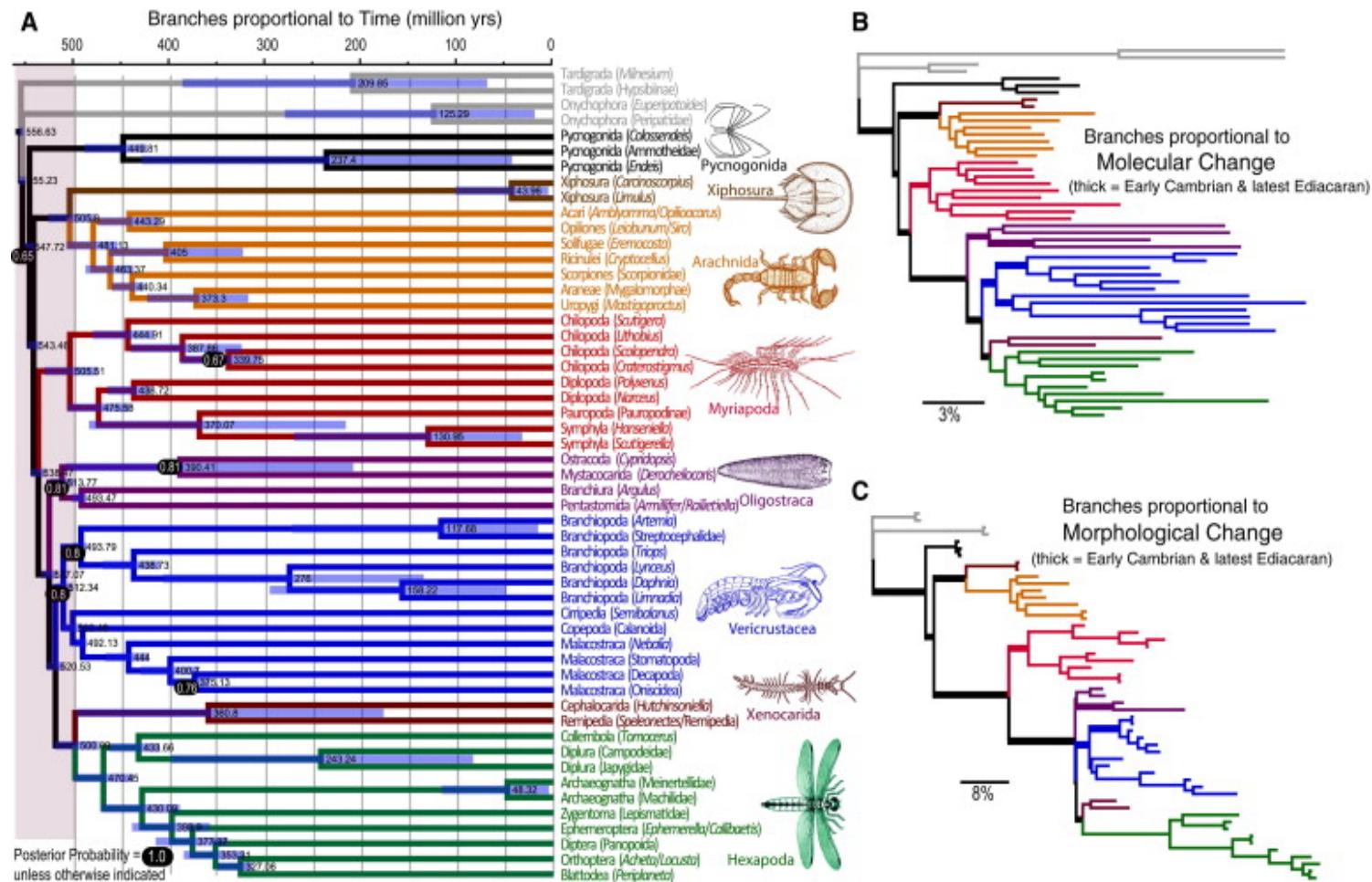


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Why did the Cambrian period explode? (*still marine life*)



All major phyla exist by Cambrian (530 million years ago)



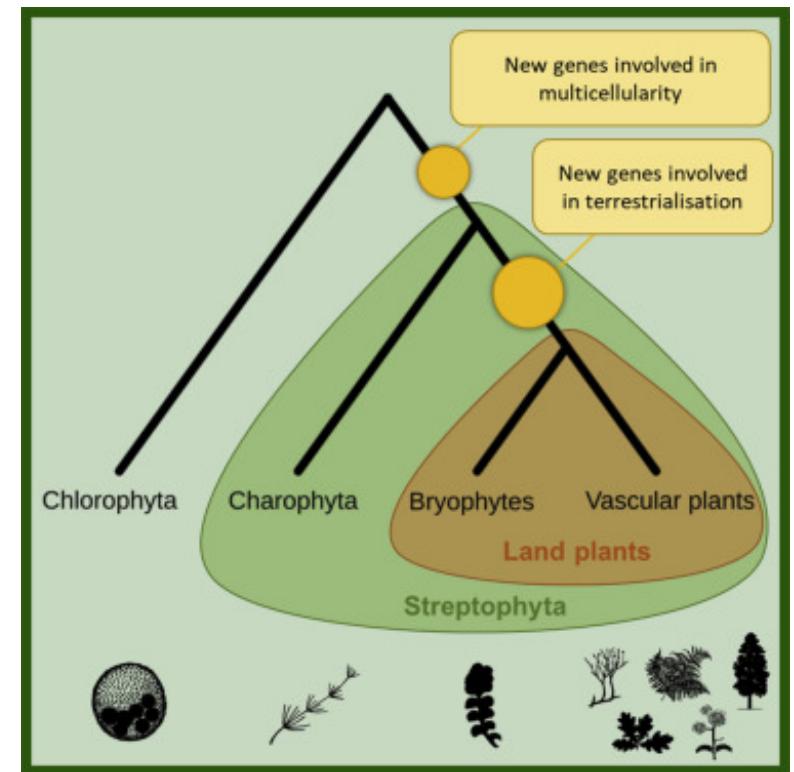
Next rapid diversification occurred on land (400 MYA)

Starts with colonization by fungi and plant ancestors

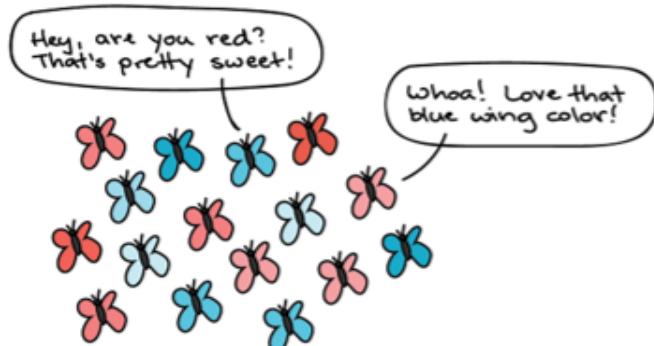
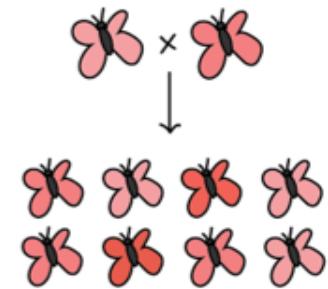
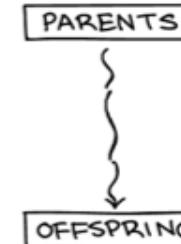
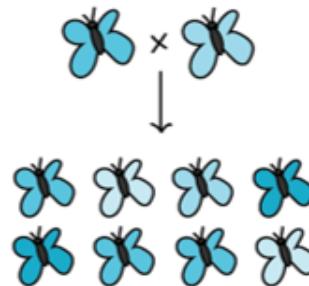
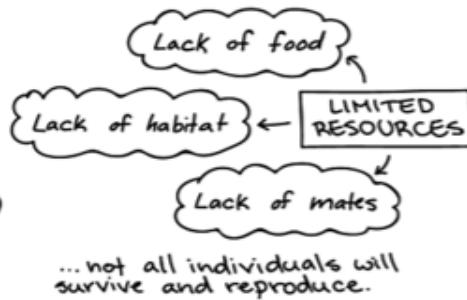
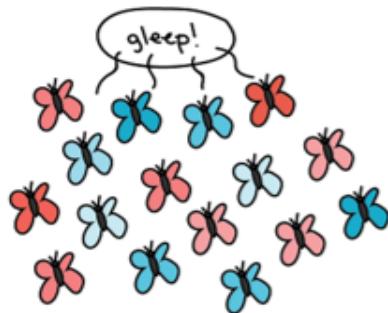
Generated new habitats/resources for land animals to evolve

Insects → amphibian/reptiles → mammals → humans

Animal life you are most familiar with are recent additions

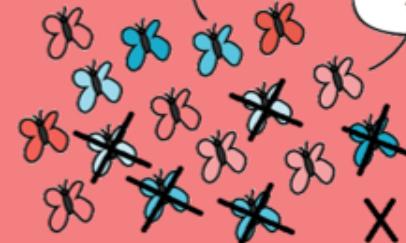


The diversity of life on earth is shaped by evolution



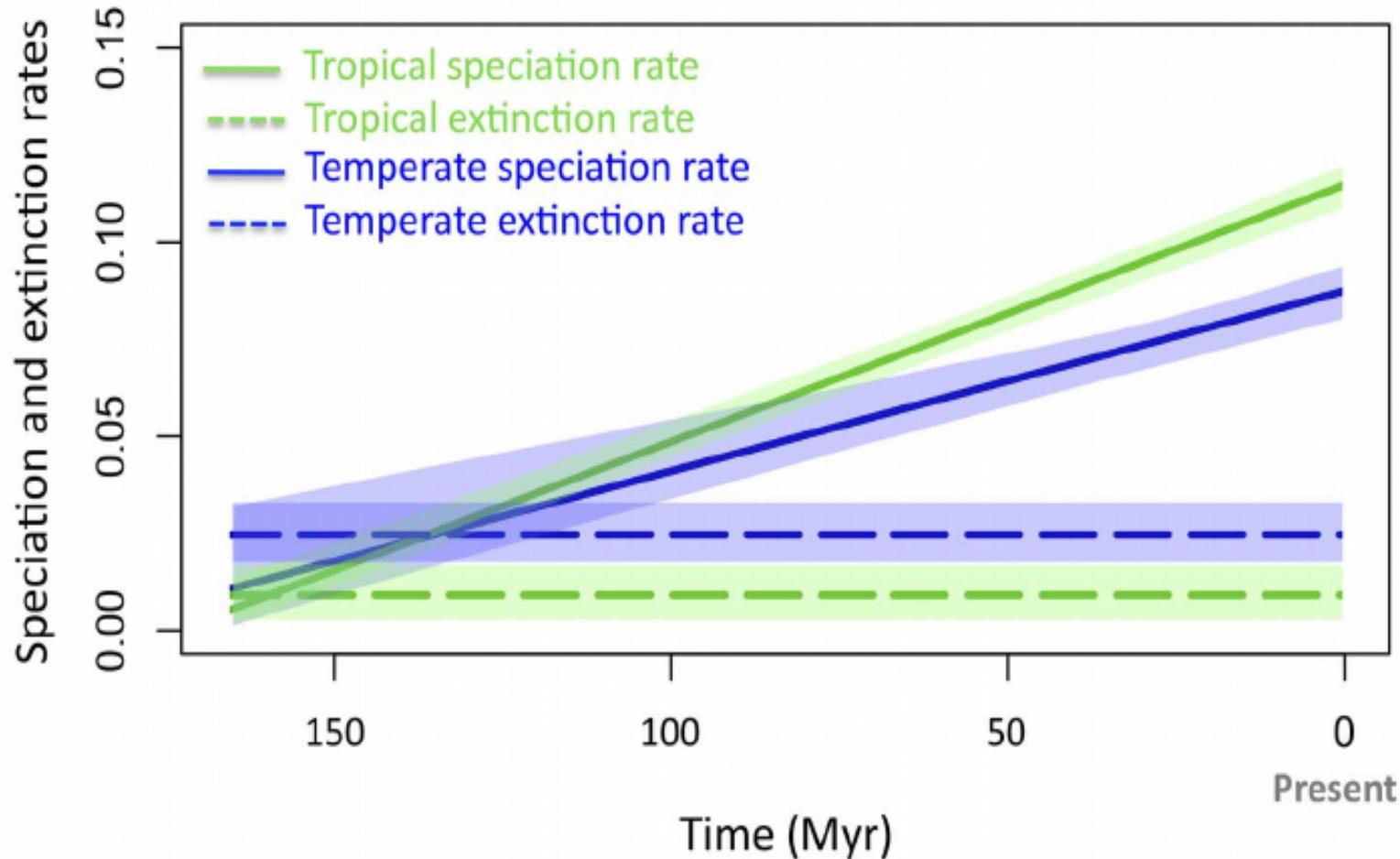
* Butterflies do not actually talk! Cartoon for cute illustration purposes only ☺

Oh no... I really stand out in this new environment!
I'm sure lucky that I blend in!

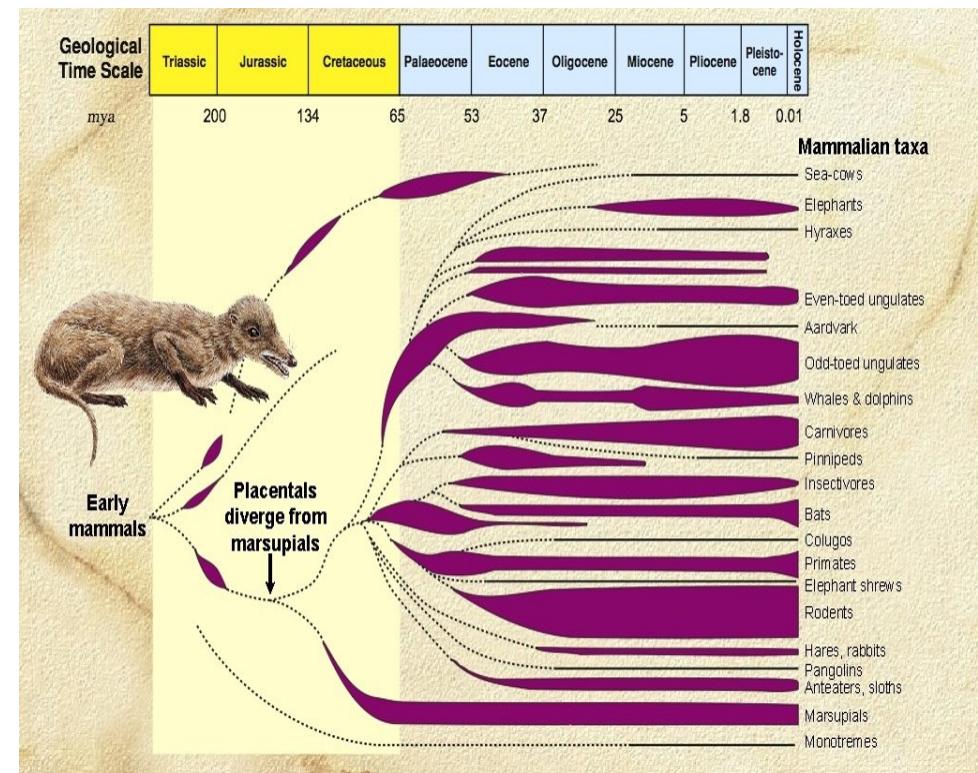
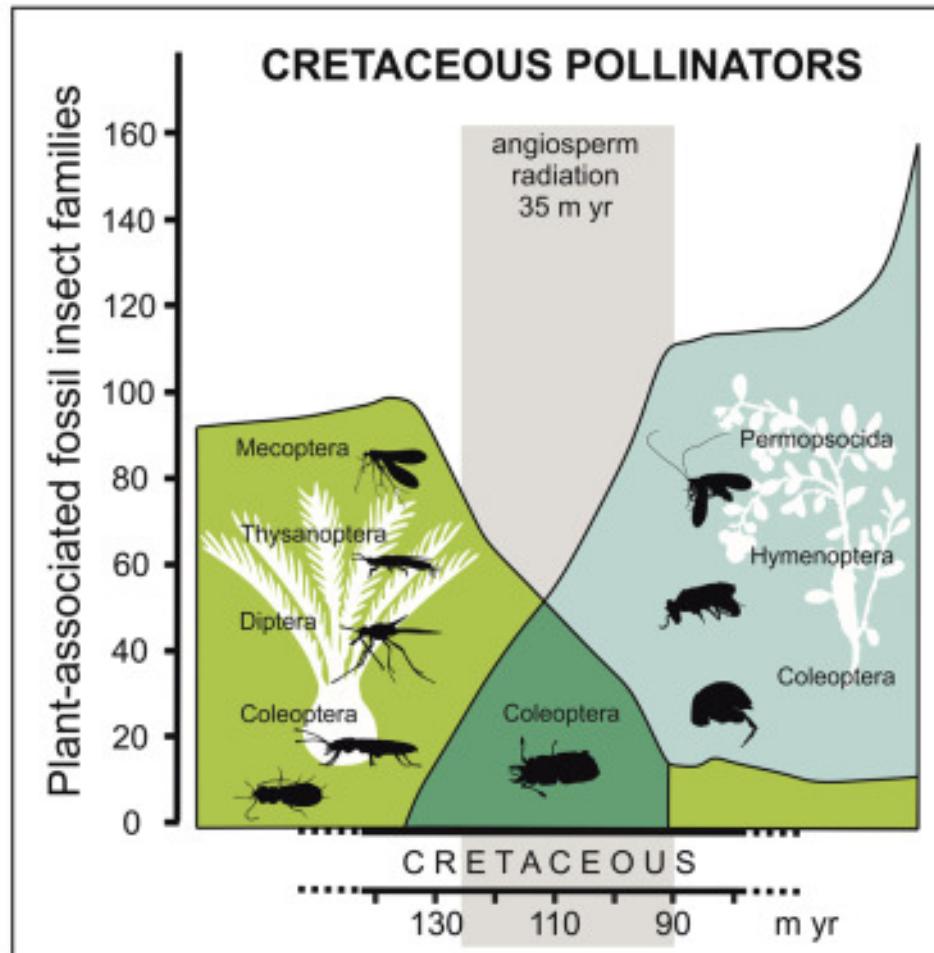


X = eaten by a bird

The diversity of life on earth is shaped by creation and removal



Speciation events (and thus diversification) can happen quickly

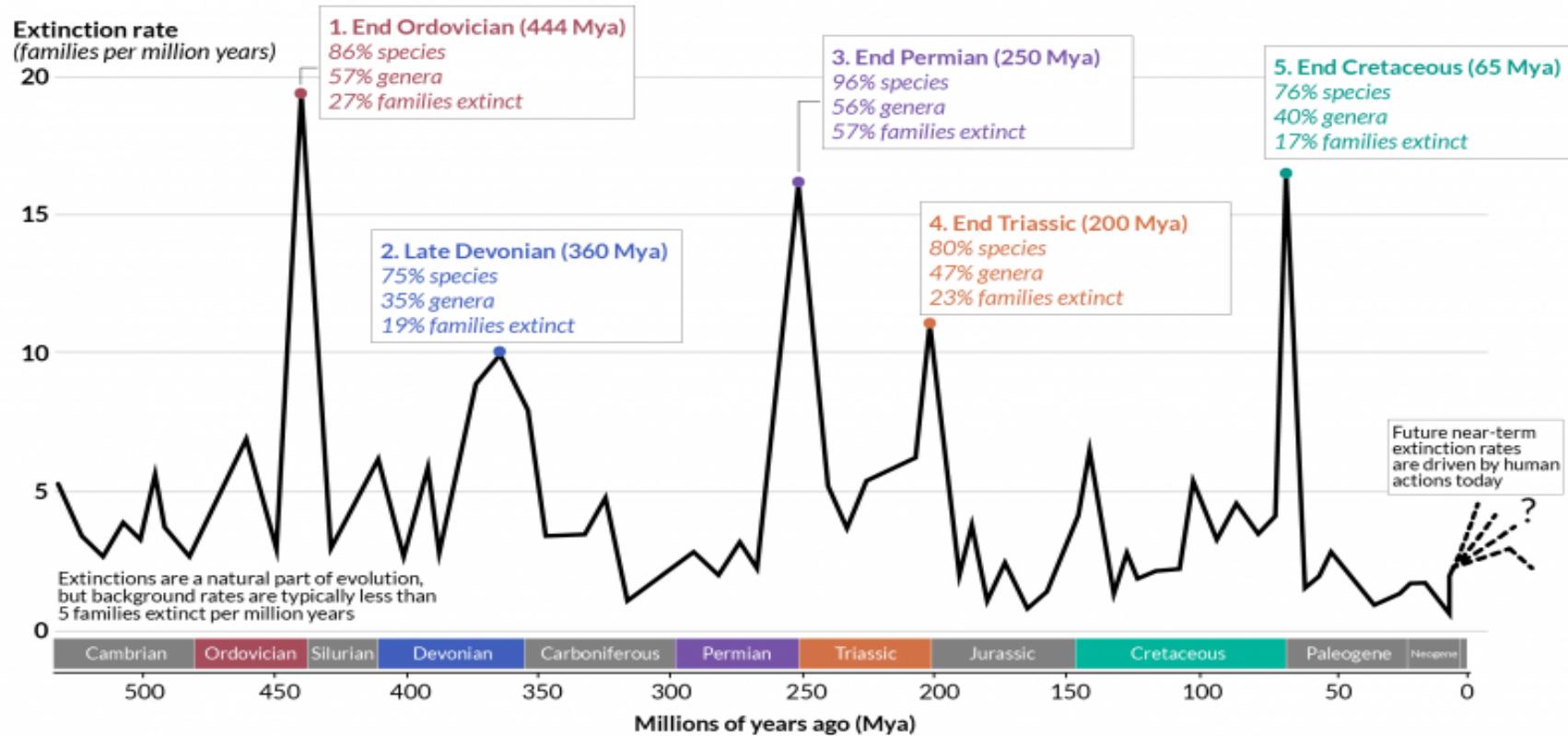


Large extinction events disrupt the progress of diversity

'Big Five' Mass Extinctions in Earth's History

A mass extinction is defined by the loss of at least 75% of species within a short period of time (geologically, this is around 2 million years).

Our World
in Data



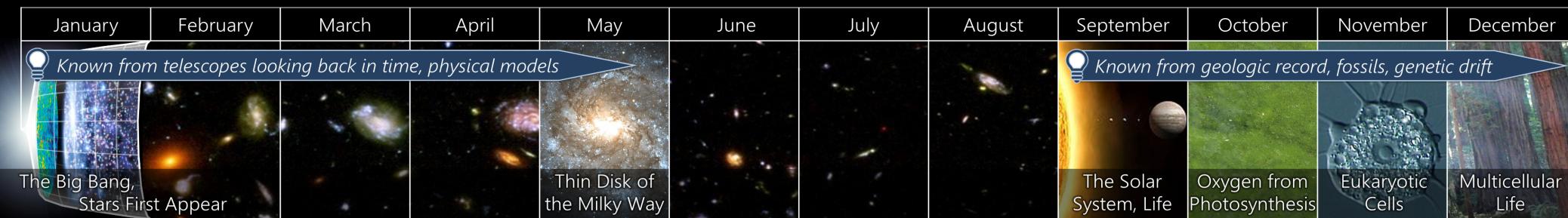
Sources: Barnosky et al. (2011); Howard Hughes Medical Institute; McCallum (2015). Vertebrate biodiversity losses point to a sixth mass extinction.

OurWorldInData.org – Research and data to make progress against the world's largest problems.

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The Cosmic Calendar

The 13.8 billion year history of the universe scaled down to a single year, where the Big Bang is January 1st at midnight, and right now is midnight 1 year later



The Month of December...

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15 Trace Fossils Only	16			17 Bones and Shells		18 Vertebrates		19 Land Plants		20 Fish with Jaws		21 Insects	
22 Amphibians		23 Reptiles		24 Pangaea Forms		25 Dinosaurs		26 Mammals		27 Birds		28 Flowers	
29 Tyrannosaurids		30 Dinosaurs Extinct, Mammals Take Over on Land and in Sea		31 The Final Day...		Dawn: Apes and Monkeys Split		8 PM: Humans and Chimpanzees Split		9:25: Humans First Walk Upright		10:30: Human Brain Size Begins Tripling	
												11:52: Modern Humans Evolve	
												11:56 to 11:59: Human Migration	

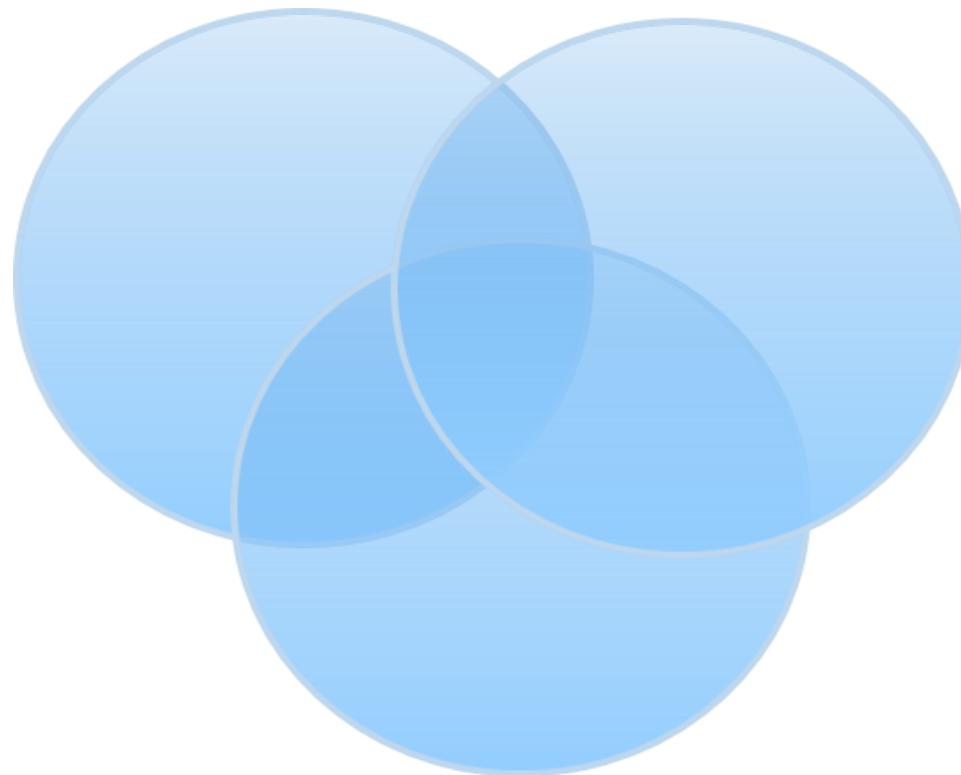
The Final Minute...

A human life only lasts for the blink of an eye on the Cosmic Calendar: $100 \text{ years} * 365 * 24 * 60 * 60 / 13,800,000,000 = 0.23 \text{ Cosmic Seconds}$



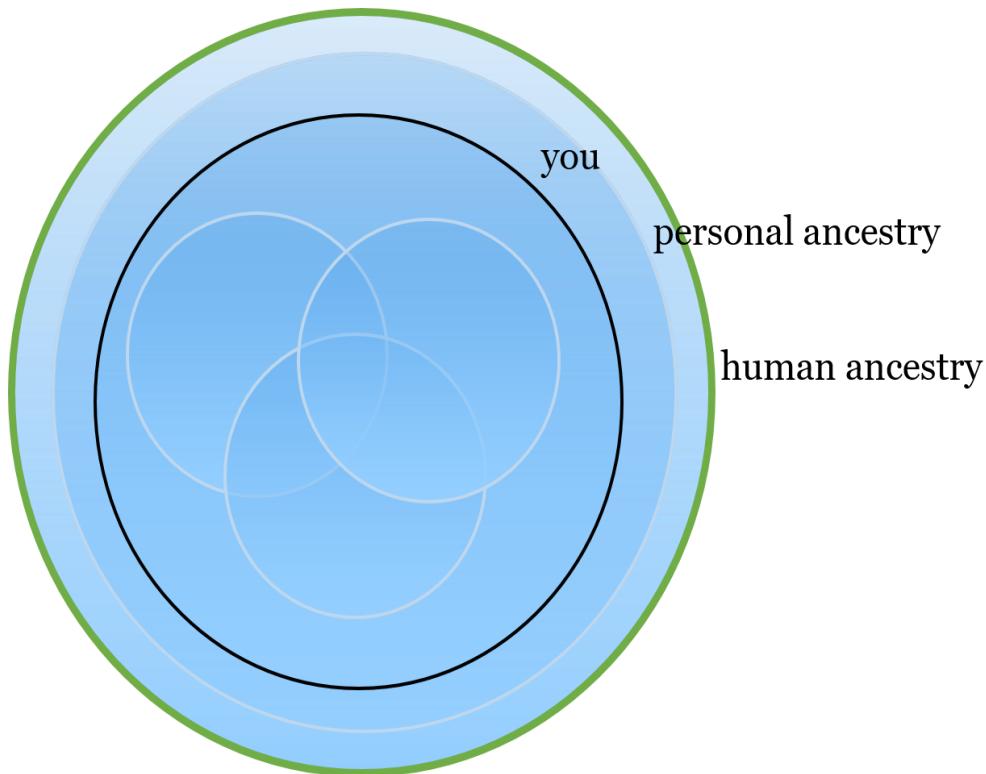
Telling the story of life on Earth: Your inclusive identity

draw aspects of your current identity



Telling the story of life on Earth: Your inclusive identity

Expand outward from your identity



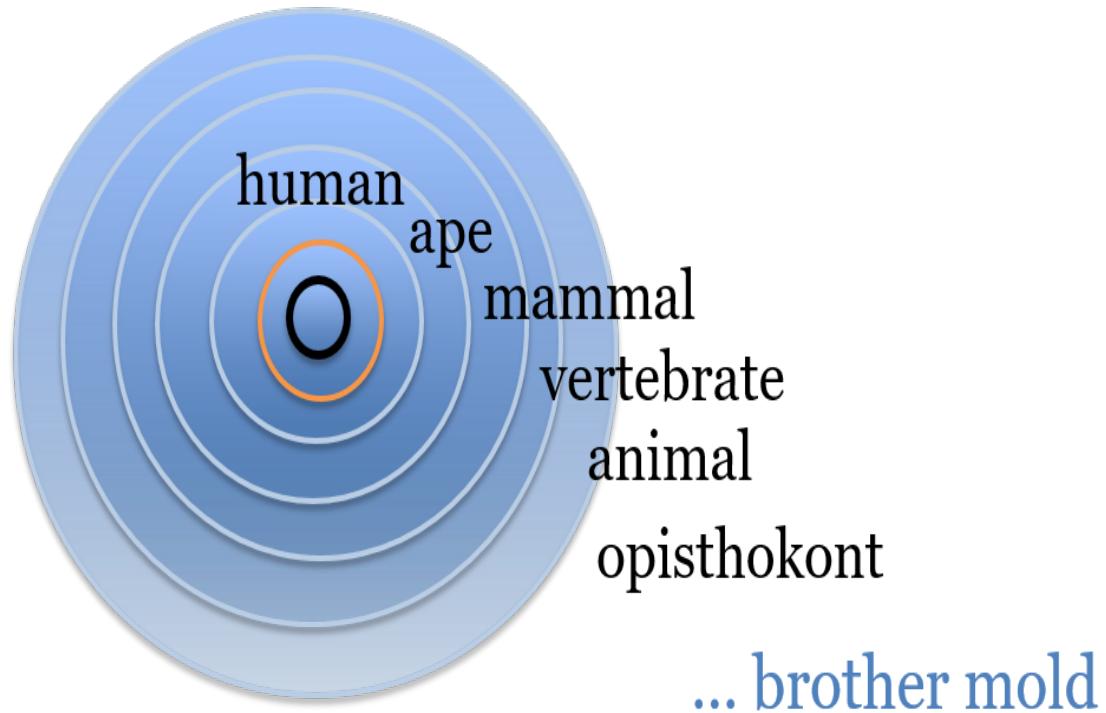
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Identity as...



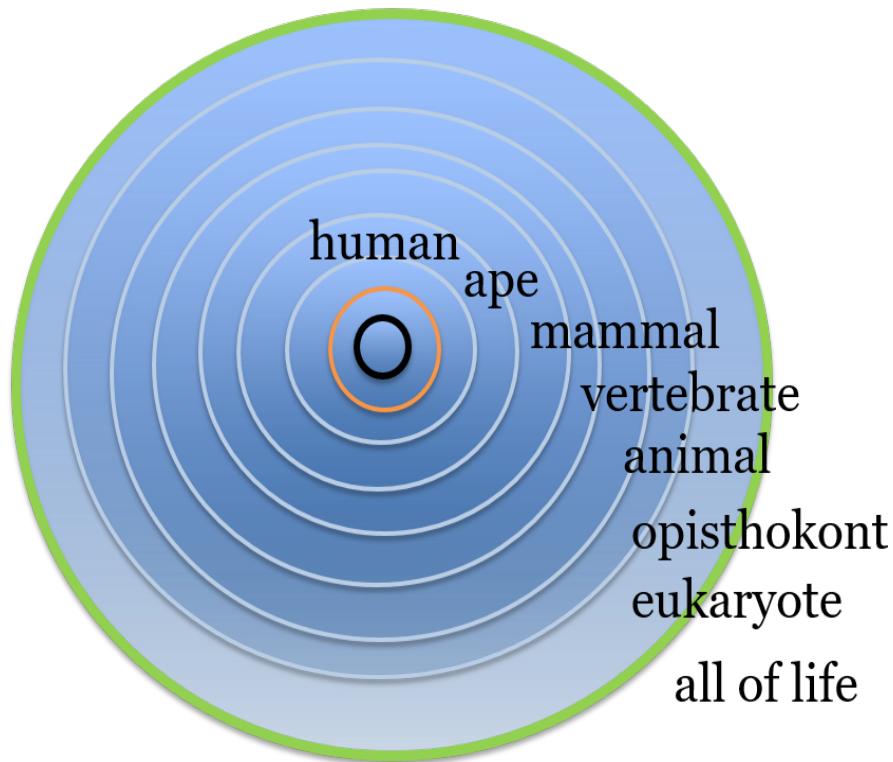
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