

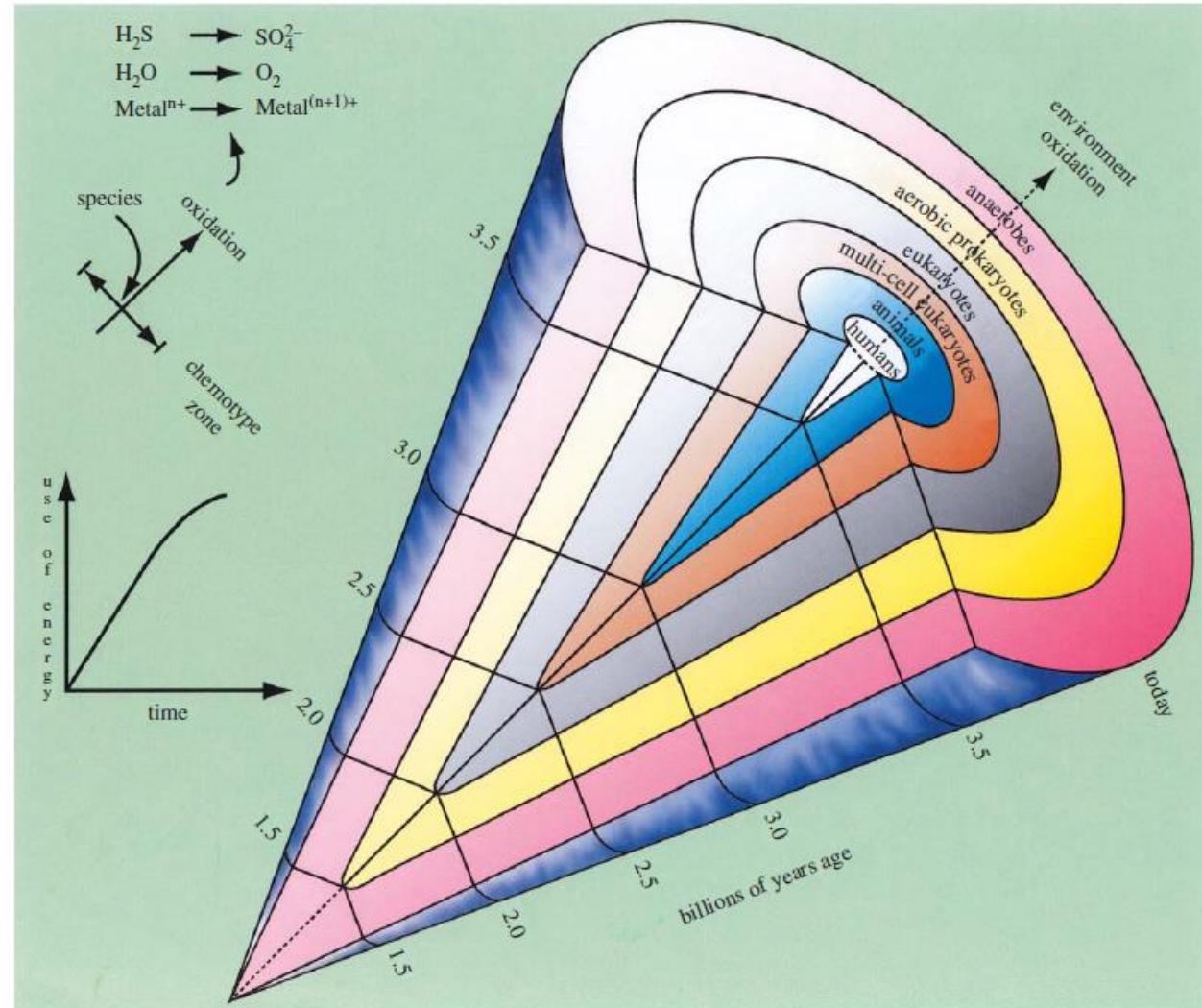
Humans: Accident or Inevitable?

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Presentation to the American
Scientific Affiliation

July 31 2017

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Graphic fm Williams, "Systems View of Evolution of Life".
It shows humans emerging amidst other more
fundamental life forms. Used by permission of the Royal
Society

Accident? So Far We Seem to be Alone in the Universe.



Image: NASA

- Physicists say that natural laws appear to be “fine tuned” in such a way that they support the existence of life itself and potentially even humans such as ourselves. (Inevitable?)
- However, there are billions of stars in our galaxy, and hundreds of billions of galaxies. Many of these stars must have rocky planets.
 - Millions of planets likely are also in “Goldilocks Zones,” near enough to their stars to support liquid water, the universal solvent of life.
 - Yet our search for signs of extraterrestrial intelligence has been unrewarded.
- If complex life was “baked in,” wouldn’t we find more evidence for it?

However, Life Appears to Need “Special Handling.”
Earth is a Very Rare Place that Supports Development of Life
Another Accident? from Hands, *Cosmosapiens*

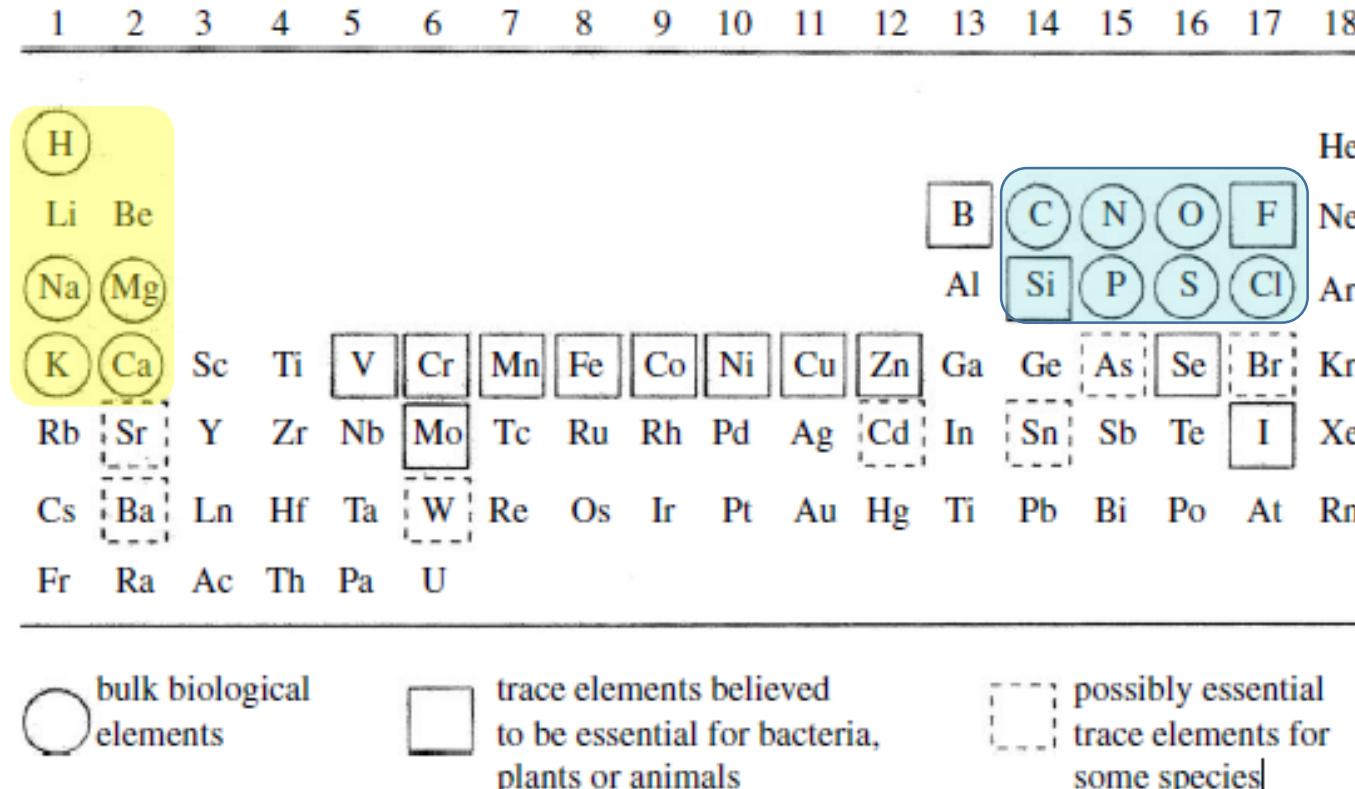
- Possesses essential elements and molecules, sources of energy, narrow temperature range, and stability for billions of years.
 - Its abnormally large iron core generates a **protective magnetosphere** that protects us from dangerous solar “wind”;
 - A thin crust enables the movement of tectonic plates to **circulate elements**; and
 - An abnormally large moon producing earth’s optimal rotation, a **stable axial tilt**, and tidal flows in its oceans.
- The planet is able to maintain a surface temperature range favorable for biochemical reactions that enable **liquid water to remain on its surface for some 4 billion years**, despite a large increase in energy radiated by its evolving parent star.
- It remains chemically stable but far from thermodynamic equilibrium over some 4 billion years. (This supports **long term change/complexification/evolution**).



Image: NASA

Inevitable? Basic Chemistry Supports the Existence of Life. Living Things Can be Made from Basic, Plentiful Elements

from Williams "Flow"



- Further, energy to Support Life Comes from chemical “Redox” Reactions.
- The elements on the left transfer electrons over to elements on the right, performing work on their way.
- (Oversimplification, but may be useful)

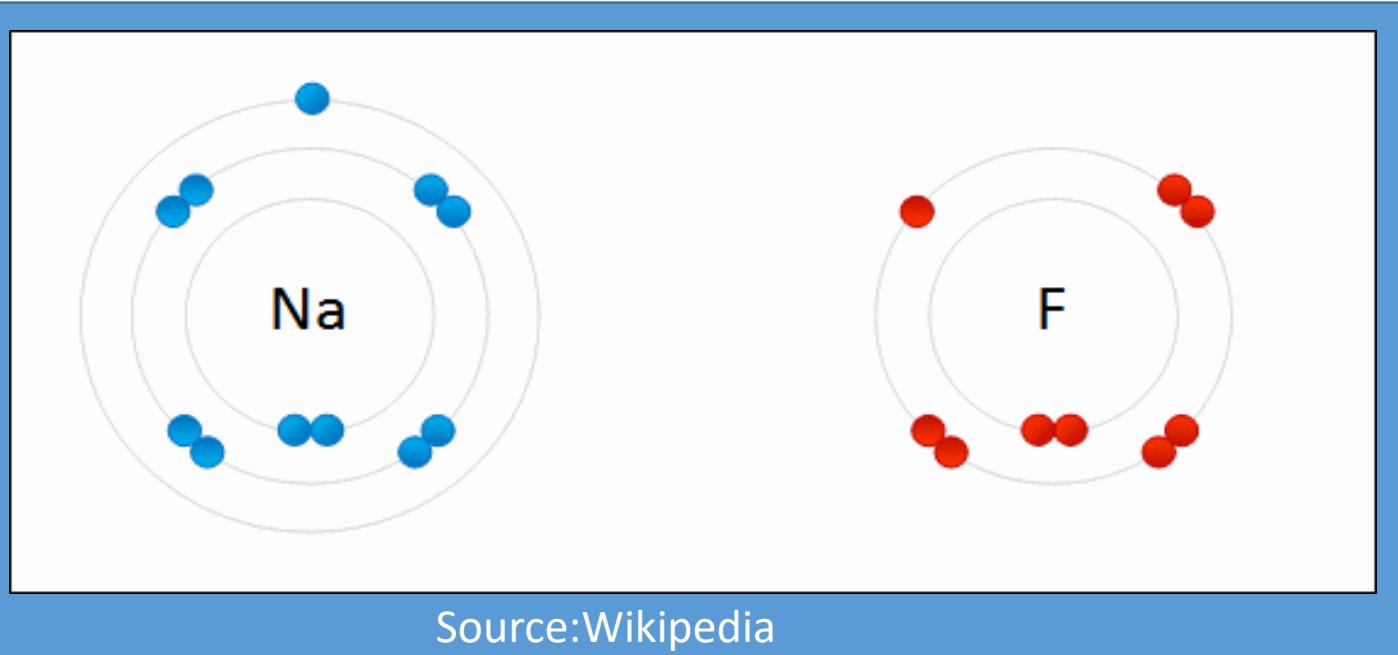
The Periodic Table showing the elements required by all life. Note how almost the whole possible variety of chemistry is covered, in that there are representative elements from 15 of the 17 chemically active groups in cells.

Graphic from Robert J. P. Williams, “A system’s view of the evolution of life”, *Interface: Journal of the Royal Society* Used by permission.

Redox Reactions:

Passing “Extra” Electrons to Atoms that ‘Need’ Them

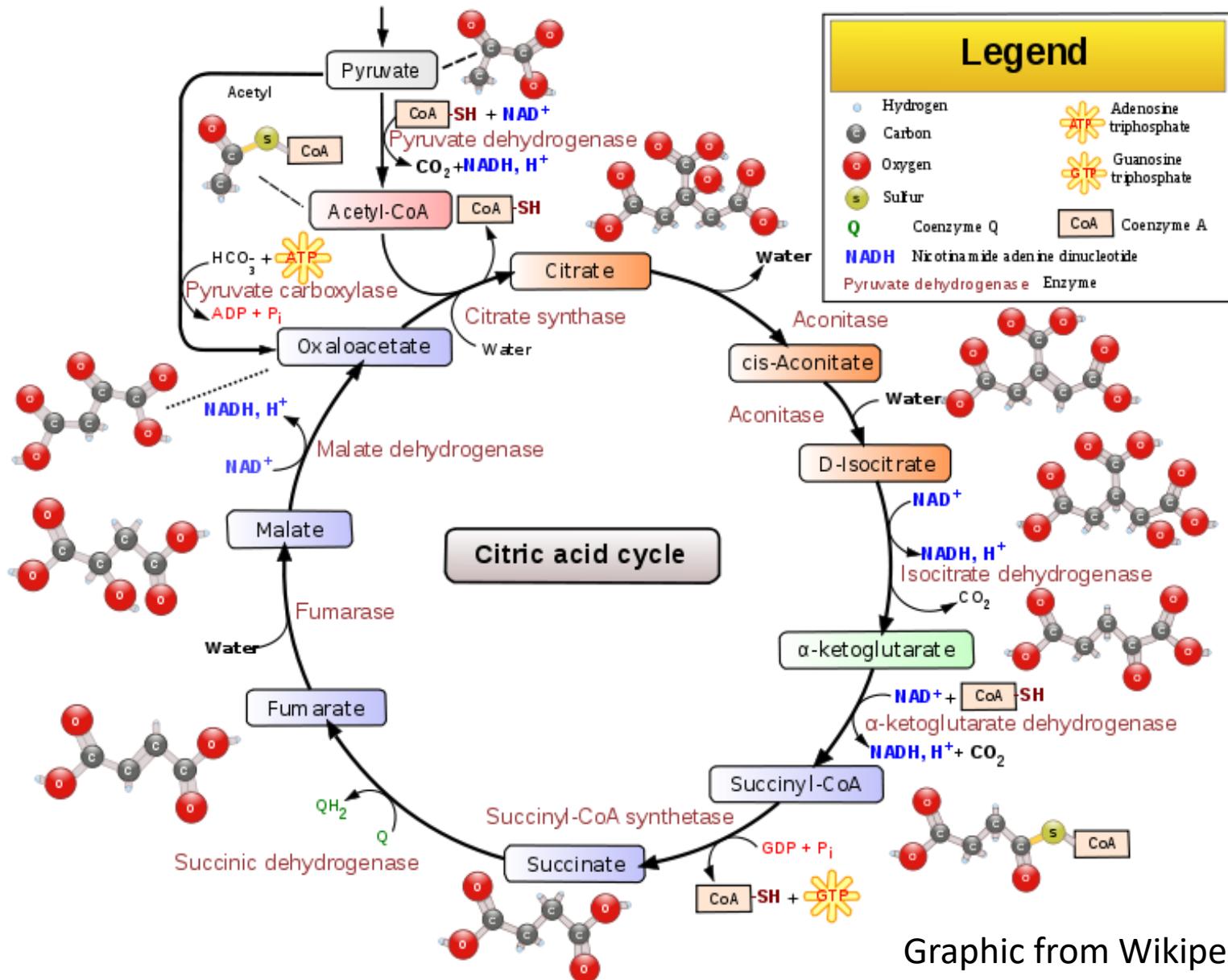
- Atoms “Want” to have a full complement of electrons- **and no more-** in their outer shell.
- Redox Reactions (Oxidation-Reduction) reactions share electrons between elements so both shells are filled.
- The remaining elements stay near each other because the ions are oppositely charged, and are mutually attracted.
- Electrons moving from one “host” atom to another can do work.
- Redox Reactions are a major source of energy for useful work in cells.



Source:Wikipedia

- A series of chemical reactions takes place in each cell.
- Each reaction produces a catalyst for the next reaction.
- Finally, the product of the last reaction produces the material to start the whole cycle over again.
- Meantime, these reactions have produced a great deal of organic materials the cell can use.
- This chain of reactions is called “autocatalysis.”
 - Roughly, “self-building.”

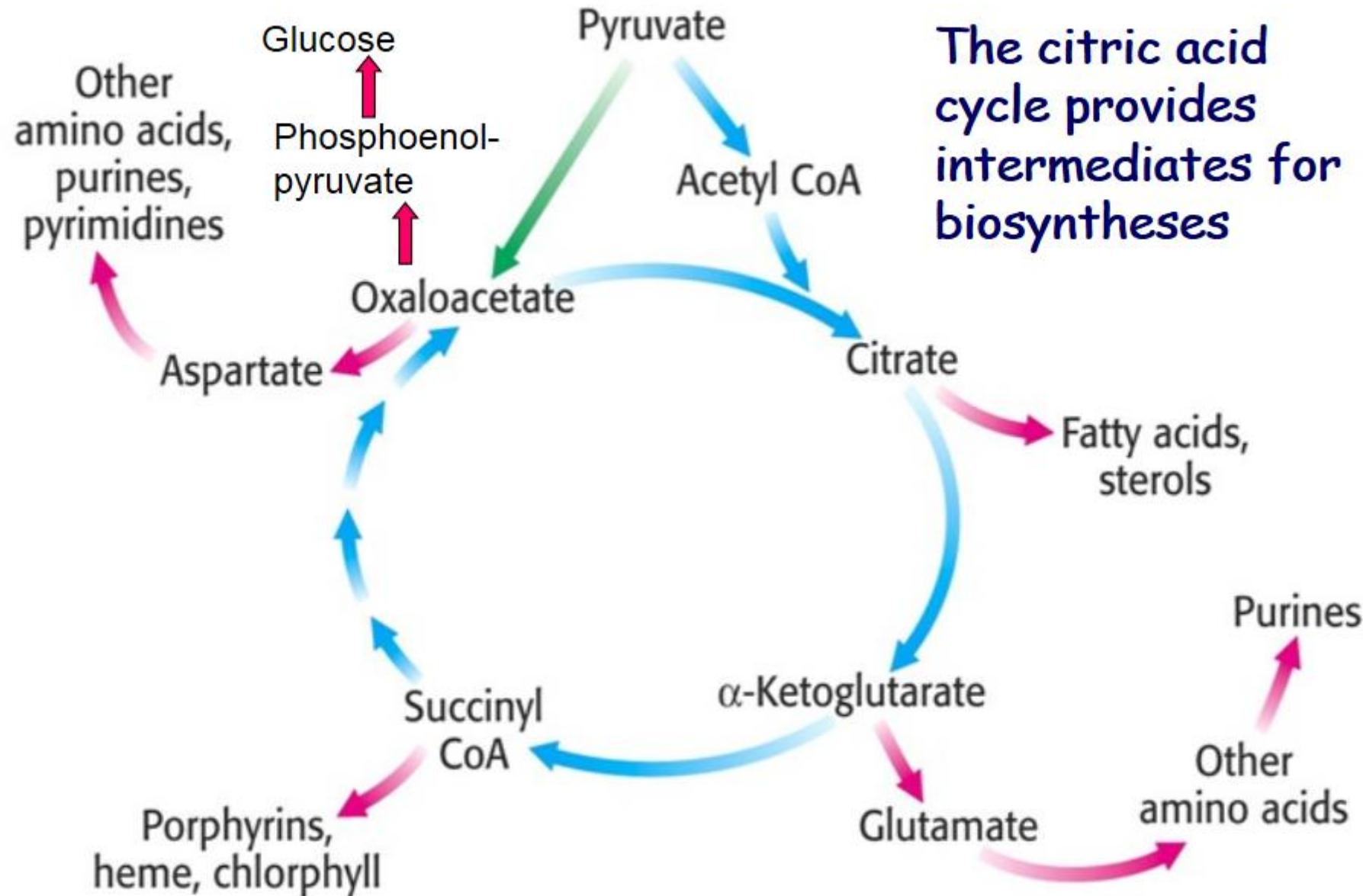
Accident? At the Heart of Cells, a Chain Reaction



Mixtures of Carbon Dioxide, H₂O, Sulfur, and Other Molecules Combine to Make Organic Molecules that Lead to an Autocatalytic Cycle, in which the Product of One Reaction Feeds the Next Reaction.

Graphic from "Oxidative Decarboxylation of Pyruvate and Krebs Cycle" by Kerrie Dickerson on Slide Player

Krebs Cycle is a Source of Biosynthetic Precursors

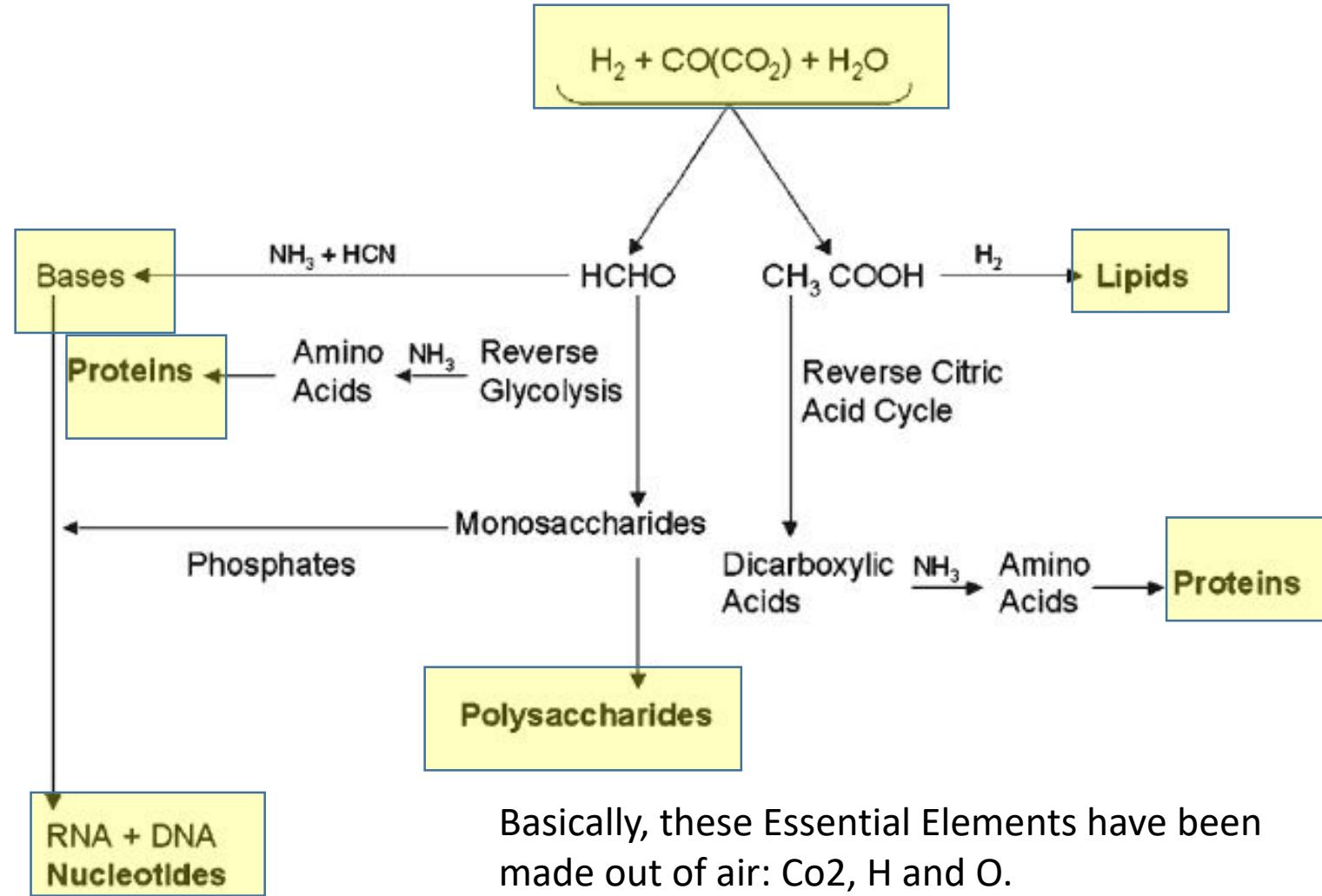


Coincidence? The Most Common Elements Combine to Form the Biochemistry of Life

From *Chemistry of Evolution*, Williams and DaSilva

The Organic Molecules Created by the Citric Acid Cycle are Feed Stock for Further Reactions that Go on to Make All the Critical Proteins, Carbohydrates, Lipids, and Nucleic Acids (RNA and DNA).

The Original Precursors are “Air:” H₂, Co₂, and O₂. [Plus Sulfur, HCN, Iron, etc.]

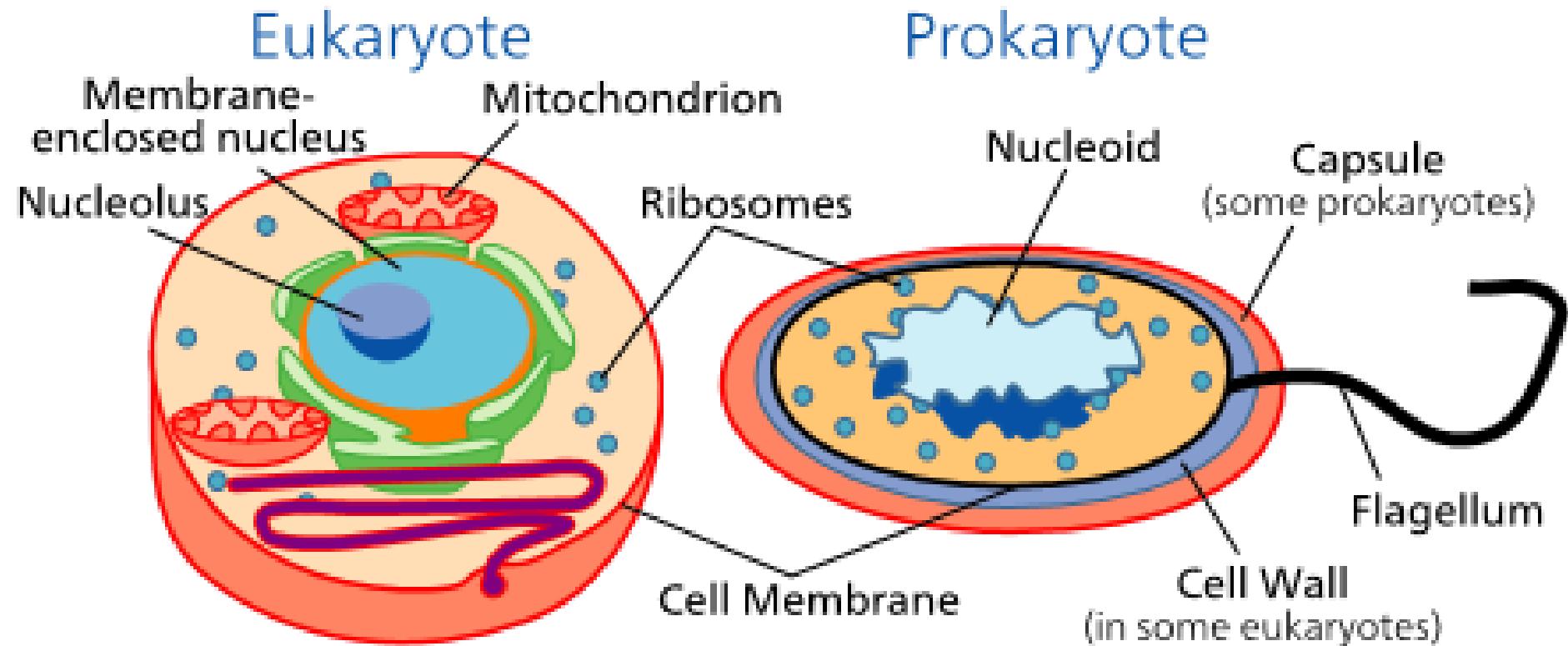


Accident?: Life Emerged Rather Quickly. Once.



- Greenland stromatolite fossils date back 200 million years before previous record holders. ("Oldest Fossils on Earth," NYT Sep 1, '16.)
 - Stromatolites: Rocklike biological structures.
- Life emerged 3.7 billion years ago, soon after earth cooled.
 - Earth is about 4.5 billion years old. Subject to Late Heavy Bombardment.
 - Similar stromatolites are still around.
- The microbes that built these structures had "Genetic code, proteins, photosynthesis, the works."
- "Life [must not be] a fussy, reluctant and unlikely thing." Rather, "[i]t will emerge whenever there's an opportunity."
 - Dr. Abigail Allwood of Caltech

Inevitable? Yes, Simple Cells Developed Once. But it Would Take a Billion Years to Become More Complex.

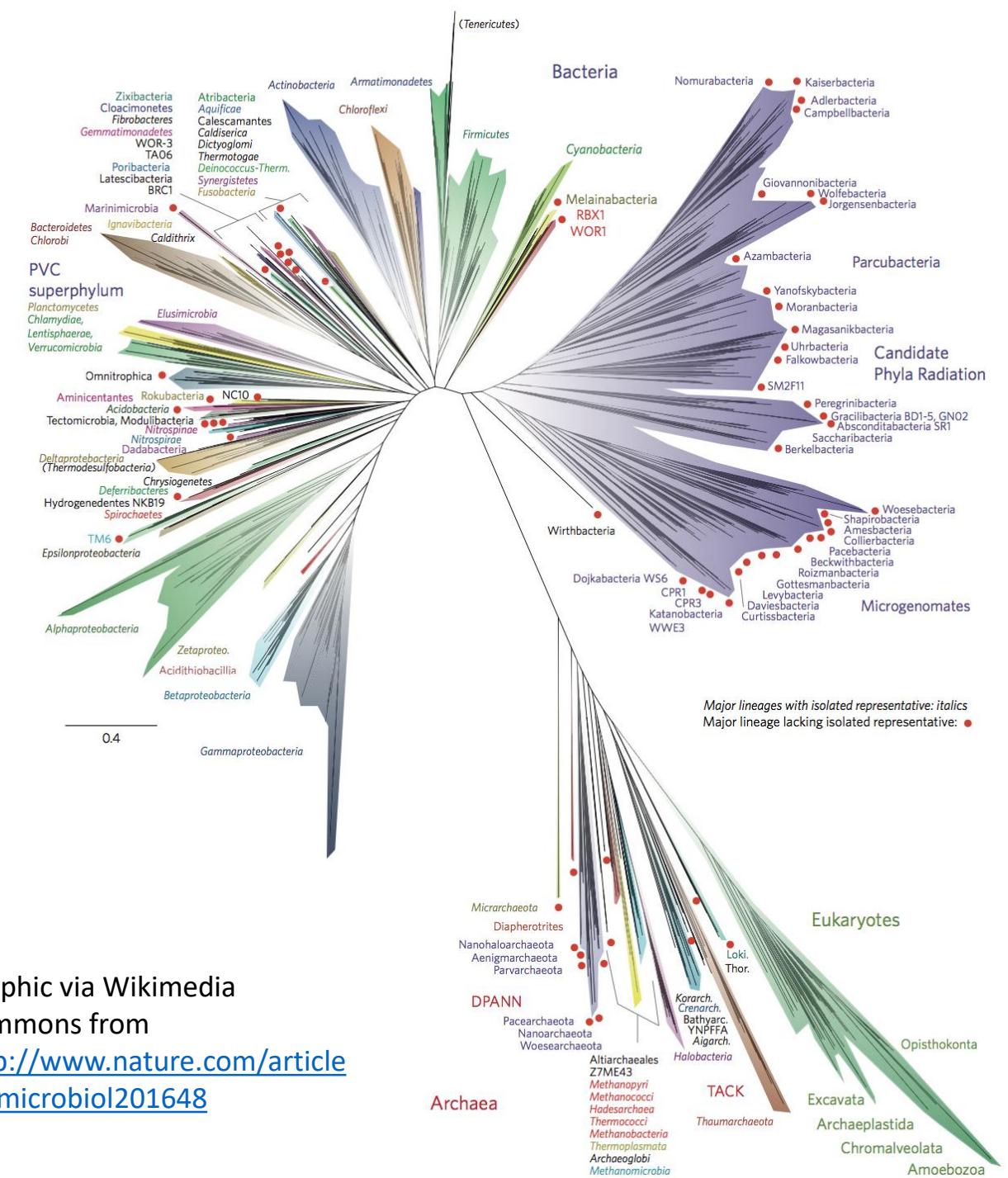


*It took More than a Billion Years
to Develop from One to the Other*

Graphic from National Institutes of Health via
Wikipedia, Prokaryotes

The Revised “Tree” of Life Is More Like a Bush or Even a Circle

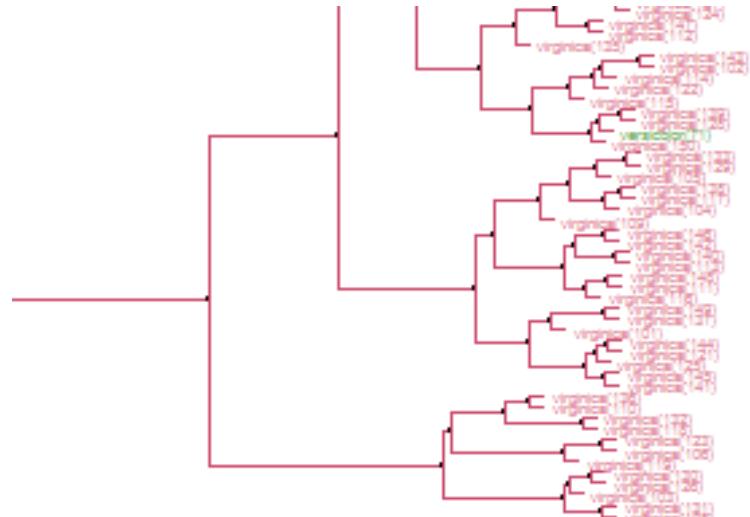
- Scientists believe that life started once, and then split into bacteria and “archaea.”
- These two microbe families swapped genes horizontally.
- Much later, these two branches combined to form complex cells called Eukaryotes, from which plants and animals descended.
- Humans aren’t at the “apex” of life.
 - We are way off on the lower right.
 - The thinness of the link suggests fluke?



Graphic via Wikimedia Commons from
<http://www.nature.com/article/s/nmicrobiol201648>

Accident?: 3 Billion Years of Unicellular Life Was Interrupted by 5 Million Years (Only) of Intense Creativity. Stephen Gould, 1994

- Around 537 million years ago, the first well-documented multicellular animals appeared. Virtually all the animal phyla appeared abruptly in the fossil record.
- “**From the flowering of dinosaurs to the origin of human consciousness...the subsequent history of animal life amounts to little more than variations on anatomical themes established during the Cambrian explosion within five million years.**
- “**Three billion years of unicellularity, followed by five million years of intense creativity and then capped by more than 500 million years of variation on set anatomical themes can scarcely be read as a predictable, inexorable or continuous trend toward progress or increasing complexity.**”
- “**Only one member** of our chordate phylum, the genus *Pikaia*, has been found among these earliest Cambrian fossils”. (No vertebrates, no humans).



Example Dendrogram, from Wikipedia

Accident?: “Humans arose as a fortuitous outcome of thousands of linked events.” Stephen J. Gould, *Scientific American*

- “Any accident could have been different & sent history on an alternative pathway that would not have led to consciousness.
- “Some **lobe-finned fishes** evolved fin bones with a strong central axis capable of bearing weight on land, and vertebrates (eventually) became terrestrial. (See photo above).
- “If a **large extraterrestrial body** had not struck the earth 65 million years ago, then dinosaurs would still be “dominant and mammals insignificant (the situation that had prevailed for 100 million years previously).
- “If a small lineage of primates had not evolved **upright posture** on the drying African savannas just two to four million years ago, then our ancestry might have ended in a line of apes that, like the chimpanzee and gorilla today, would have become ecologically marginal and probably doomed to extinction despite their remarkable behavioral complexity.



Inevitable?: Multiple Compatible “Fine Tunings,”

From Michael Denton, *Anthropic Principle*



- The properties of the most essential **elements are peculiarly fit for life** as it is on earth, in a profoundly synergistic and parsimonious way.
 - “The compound **water** serves as the **matrix of the cell**, but also fit because of its **low viscosity** for the circulatory system in higher organisms. Its **thermal properties help cool** warm-blooded organisms...
 - **CO₂** is fit to **distribute the carbon atom throughout the biosphere...**
 - “**Water and CO₂** are made up of the three atoms that together form the universe of organic chemicals, **the material basis of all living things.**”
- “Higher” life forms have more **rapid metabolisms** than molecular life.
 - Mammals require **advanced circulatory and respiratory systems** to spread through the body nutrients, respiration, and to take away waste products.
 - Human brain may use 20% of the body’s energy. It relies on high metabolism.

Some Inferences

- The fine tuning of physics and chemistry have set the conditions for life to emerge.
 - A physical/chemical predisposition to life?
 - However, the extreme complexity of life and its demanding requirements militate against that potential being fulfilled.
- “Environmental Possibilism.” Within the circumstances provided by the conditions of the universe, the chance for complex life to come about exists.
 - Within this possibility space, chance, will and providence have combined to make the world what it is.
- Humans have freedom and responsibility.
 - The possibility exists to fulfill the potential.



Suggested Additional Reading

- Cosmic Fine Tuning:
 - Luke Barnes [The Fine-Tuning of Nature's Laws - The New Atlantis](#)
- Chemical Characteristics that Tend to Support Life, by Michael Denton
 - [The Place of Life and Man in Nature: Defending the Anthropocentric ...](#)
- Robert J.P Williams. “A system's view of the evolution of life”
 - <http://rsif.royalsocietypublishing.org/content/4/17/1049>
- Nick Lane. “Life: Inevitable or Fluke?”
 - <https://www.newscientist.com/article/mg21428700-100-life-is-it-inevitable-or-just-a-fluke/>
- Stephen Gould. “The Evolution of Life on Earth” <http://brembs.net/gould.html>
- Christian deDuve. *Vital Dust: The Origin and Evolution of Life on Earth*
- Other Material by Dr. Siegrist [Browse by Last Name - The Christian Mind](#)