

UNIVERSALLY VALID PRECONDITIONS OF THE BIOCHEMISTRY OF LIVING MATTER

(The biochemistry of all living matter in the universe/space is similar to the living matter on earth)

1) Introduction

Since the publication of NASA/Wolfe-Simon in Science on 2 December 2010, there is a worldwide commotion on whether Arsenic can be found somewhere in a living matter on earth. That discussion is globally analogous to Silicon. Based on the biochemistry of the living matter on earth, in this article it is systematically considered which physical, chemical and energetic preconditions are universally valid for the biochemistry of existing forms of living matter, assuming that universally all matter/atoms are built up according to the elements of the Periodic Table. See document G1 www.uiterwijkwinkel.eu

2) Life on earth is based on the biochemical scheme of Biochemical Pathway (BP)

In the 80s and 90s of the twenty first (21st) century a group of biochemists under the leadership of Gerhard Michal et al. have done a gigantic work by clarifying the biochemistry of the living matter on earth. This group have made the three central biochips clearly visible and then linked biochemical reaction pathways, and as a whole worked them out into the great [so called] biochemical schemes of the Biochemical Pathways (BP). On earth, the Periodic Table of elements has resulted in one biochemical system where all forms of life are based.

Three biochips are pillars of the biochemical pathway

- a) Citric acid cycle (with the building and breakdown of different carbohydrates)
- b) The fatty acid cycle (with the building and breakdown of different fatty acids)
- c) The amino acid synthesis (with the building and breakdown of different amino acids)

These three cycles form the three biochemical computer chips of the living matter on earth and are central in the biochemistry of the living matter. The three cycles are attached to different biochemical reactions chains", which as a whole form Biochemical Pathways. These gigantic schemes of BP are best comparable to a "biochemical computer" with three processors. All forms of life on earth are based centrally on a biochemistry that is wholly or a greater part of reduced to a Biochemical Pathway (BP).

The different forms of photosynthesis result universally exclusively in the form of L-glucose. This glucose forms the driving force behind the biochemistry of all living matter. Glucose is also basic in the formation of different organic bonds where living matter is built.

3) Research Questions

What are the underlying principles of BP? Is something other than the BP possible in space/universe? How about Arsenic in living matter? Does Phosphorus allow itself to be replaced by Arsenic? First an analysis of BP and of the living matter on earth!

4) Analysis of Biochemical Pathways

a) In BP it is directly visible that all molecules are dissolved in a reaction medium/liquid. The molecules are minute/smaller and exist as dissolved mono-molecules built up of five elements of the Periodic Table: C, H, O, N, S. The sixth element Phosphorus is only found at the periphery and only in the form of ADP/ATP, DNA and bone tissue

b) All biochemical reactions within BP are achieved through displacement and pairing of electrons. Radical reactions are structurally absent!

c) Metals like Fe, Co, V and the likes are exclusively found in BP in the form of dissolved metal ion (within chlorophyll or haemoglobin molecule). The metal ion can gain or lose an electron in this state. The metal ions only act as catalysts. Calcium and Phosphorus are found in bone tissue

d) Metals and such are not really involved in chemical bonding within BP

e) Photosynthesis results exclusively in the formation of glucose

f) Looking at the biochemical reaction paths of BP it appears that different mono-molecules constantly appear in three physical states namely: 1) dissolved gas, 2) dissolved charged particles/ions and 3) dissolved, neither gaseous nor charged, molecule/particle **nopression**. These are the maximum possible physical states of the dissolved molecules within BP. The fourth physical possibility is gaseous combined with charged [for example] ion cannot react within dissolved molecule.

g) The three physical states also appear to be the minimum requirements for the ongoing biochemical reactions to run smoothly as series of reactions within BP. In practice biochemical reactions exist in one varying chemical reaction combination, with physical changes within the three existing/available physical possibilities. These biochemical reactions are only possible with the help of specific enzymes.

5) Basic/core biochemistry of living matter

All biochemical reactions in BP get blocked when:

1) with the available molecules, only two of the three physical dissolved states are possible

2) in a reaction medium, only two of the three molecules are dissolvable in a physical state. Gases, charged particles/ions and nopression molecules should be able to dissolve next to each other in a reaction medium.

3) There is no reaction possible between the molecules, particularly those achieved through displacement of electron pairs.

These demands/preconditions are not only valid on earth but also in the universe/space.

6) Results/consequences of the physical demands

a) Only the elements C, H, O, N and S are central in BP:

There are billions of molecules possible on the basis of around 90 stable elements of the Periodic Table. Only small mono-molecules made up of C, H, O, N and S exist through displacement of electron pairs in physical states as -) gas, -) charged molecule/ion and -) non-gaseous and uncharged molecule/ion. Due to the physical reason, BP is primarily structured around mono-molecules built up of elements C, H, O, N and S. Metals only exist in the BP molecules as dissolved ion and never as chemical bonds.

All other combinations of the elements of the Periodic Table including Phosphorus and Silicon result, as molecules, in maximum two of the three required physical states. It is not possible to form molecules of dissolved gases from phosphorus, silicon and other elements. For that reason it is not possible to form series of consecutive biochemical reactions with molecules where Si and P are incorporated, unlike with the molecules of C, H, O, N and S. Because of that physical reason there is universally no phosphorus, silicon, arsenic or any other element on earth in the central biochemistry of the living matter in the BP schemes, apart from C, H, O, N and S! Pure physical reasons limit the central biochemistry of all living matter in the universe to molecules exclusively built up of elements C, H, O, N and S.

b) Chemical essence of biochemical reactions:

It appears that all (bio)chemical reaction steps develop through constant displacement of one electron pair within BP. To enable the building or break down of the chemical bonds, for every step specific enzymes are required as catalysts. Pure radical reactions do not exist. There is however the issue of half-radical reactions where a temporary free electron (= radical) is involved.

That formation or breakdown of chemical bonds through displacement of electron pairs is only possible with molecules built up of elements C, H, O, N and S. It is only with these molecules that consecutive chain reactions biochemical reactions is possible. Due to the reasons mentioned under a) and b), it is universally only possible to build the biochemistry of the living matter around elements C, H, O, N and S.

c) Only one type of carbohydrate, fatty acid and amino acid:

With the five elements C, H, O, N and S of the Periodic Table, it is only possible to build one basic type of carbohydrate, one basic type fatty acid and one basic type amino acid. That is also universally valid. We find the same carbohydrates, fatty acids and amino acids in all living matter in space as on earth. At the same time only one basic type protein and one basic type DNA has been found in space.

d) Only water is suitable as a reaction medium for biochemical reactions:

All 100% pure liquids can dissolve: a) gases and c) non-gaseous/uncharged molecules. From all thinkable pure liquids water is the only molecule that on its own can disassociate in and Off ions. Water is therefore the only pure liquid where the following can dissolve next to each other: a) gasses, b) charged particles/ions. and c) non-gaseous and uncharged molecules (glucose, fructose, non-disassociated amino acids etc...

Charged particles/ions cannot dissolve in all other 100% pure liquids. Those liquids offer biochemical reactions where only two of the three required physical dissolved states are possible. In terms of dissolving power, water is the only liquid that is universally physically suitable for the development/achievement of biochemical reactions.

e) Energetic preconditions for water:

Besides physical characteristics, a reaction medium should also be energetically suitable for achievement of biochemical reactions. None of the molecules/molecule bonds in the BP may have a lower physical and chemical energy position than the reaction medium itself. The reaction medium must always have the lowest thinkable physical and chemical energy level, compared to all the thinkable chemical and physical bonds. Through the O-H bond and the highest condensation heat/temperature and solidification heat, water meets these two energy conditions. Due to the reasons mentioned under d and f, water is the only thinkable reaction medium that is universally both physically and energetically suitable for the development of biochemical reactions; and particularly water contributes important biochemical H_3O^+ and OH^- ions.

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In living cells water functions perfectly as a cooling medium for transportation of warmth emitted from biochemical reactions, and is further perfect for the transportation of nutrients and the transportation/emission of waste product! Far better than any other thinkable liquid.

f) The biochemistry of living matter universally:

Generally the central biochemistry of the living matter is universally mandatory arranged around mono-molecules built up of elements C, H, O, N and S, with water as the only suitable reaction medium! For a full top-down analysis and bottom-up deduction the author refers you to document B1 www.uiterwijkwinkel.eu

g) The role of Phosphorus and Arsenic:

In the central biochemistry of the living matter, we do not see phosphorus or any other elements in chemical bonds. We see phosphorus in very limited amounts, and only appearing at essential places in: h) DNA, i) ADP/ATP (energy deposits and storage) and j) bone material.

h) Functions of Phosphorus in DNA:

The function of phosphorus in DNA is primarily to inhibit the many enzymes in the cell from dividing/breaking down the cells' own DNA through hydrolysis. The presence of phosphorus in DNA inhibits the enzymatic breakdown. With the DNA there could also be control, protein synthesis and destruction of genetic information of the cell.

Under extreme conditions (like Lake Mono, California) protection of DNA can be achieved through replacement of phosphorus in the DNA with a strongly similar element Arsenic. In that perspective/way the claim of NASA/Wofe-Simon is not strange. The arsenic atom is greater than phosphorus atom. Theoretically it is undoubtedly widely deduced and calculated if DNA can still function with arsenic as double-helix compared with DNA with only P.

i) Arsenic (As) possible in ADP/ATP?

The energy storage and release through ADP/ATP in the cell should be central to the biochemistry of the cell. Only for that reason, P should absolutely not be suitable for the central biochemistry and that is the case in ADT/ATP. Can arsenic now be found in ADP/ATP instead of phosphorus?

It is not unthinkable that cells under extreme conditions with little/limited phosphorus than arsenic can be used as replacement of PO_4 instead of ADP. ADP could appear as AAsP or as AAsAs. This could not be extraordinary. It becomes extraordinary only when the energy containing third phosphate group PO_4^{3-} could also be replaced by an arsenate group (AsO_4^{3-}).

Arsenic is released by breakdown of arsenic containing "ADP/ATP", and that is poisonous for most organisms because molecules with arsenic are not easily dissolvable in water. Living cells can only withstand one inorganic precipitation within the cell. The extreme difficult dissolvability makes it again doubtful that arsenic is structurally used within the cell.

7) Wolfe-Simon's article

Eventually replacement of P with As is thus not impossible, and given the situation in Lake Mono is expected. What should be condemned is that Wolfe-Simon's article is not freely accessible on the internet. For me, I cannot confirm/check/control where and how Wolfe-Simon confirmed that As is indeed replaced in DNA or in ADP/ATP. Anyway, it is not a question of alien life. NASA and Wolfe-Simon have aired/hanged out their results too early in the over-dimensioned clock.

8) Conclusions

a) The central biochemistry of the living matter remains unchanged also in Lake Mono, just like shown in the Biochemical Pathways of Gerhard Michal et al.

b) In this document the author has deduced the general preconditions of the biochemistry of the living matter in the universe. The Periodic System supports/withstands only one biochemical system like Biochemical Pathways (Michal et al.)

c) All the living matter in the universe/space is forcefully anchored on exactly the same biochemistry as found on the living matter on earth. The biochemistry of the living matter on earth is strongly valid as universal standard.

d) That the Periodic System can only accept/accommodate one biochemical system like Biochemical Pathways, living matter can spontaneously develop itself on all smaller planets with enough water that is not too far away or not too close to them *)

9) References

See **document B1** www.uitewijkwinkel.eu

*) Living matter is thus to be expected on billions of planets in the universe The planets have as general characteristics:

- 1) dimensions like those of the earth ($0.8 < G < 1.5$),
- 2) for about 50-80% covered with water and ice at the poles
- 3) the mist ring with a vapour pressure of between 0.5 and 3 atmosphere, that consists mainly of Nitrogen Planets with living matter strongly resemble the earth.