Higher Standards for Science Education in XXI century

Vladimir Komarov
Department of Chemistry, St Petersburg State University, St Petersburg, Russia
Corresponding author: kvsergeich@gmail.com
Russia, 199034, St. Petersburg, University Emb. 7-9.

Abstract

The increasing amount of information requires that scientists and teachers establish its **rules of selection, sorting, ordering and contemporary presentation. Selection of information** is determined by the individual and the demands of social development in the coming decades. **Sort information** defined basic human activities and developing their methodological and logical apparatus. **Ordering information** is based on creation and allocation of a set of systems, systematics and mnemonic rules. This ordering information should perform two functions - distribution databases and identifying errors in these databases. With regard to the educational process system reporting should take into account both the conditioned reflex and unconditioned reflex components of the process of perception and assimilation of new knowledge. Under the **current understanding** of information we mean the computerized representation of a few principles from which you can easily get a set of facts (Claude Adrien Helvétius, 1759).

The first part of this article is devoted to the general principles of a Spiral Approach in Education (SAE). We selected 15 scientific disciplines that form the basis of the SAE.. These subjects should be studied from 4 to 17 years, i.e. until the end of secondary school.

The second part of this article is devoted to some theoretical aspects, which can be laid down as the basis of the study of physics, chemistry and biology. We accept and justify that the basis of the science of nature are the three fundamental representations: **Combinatorics, Homology and Symmetry.** The application of these concepts to a variety of natural objects and processes of their interaction allows us to find a number of conservation laws and selection rules for subsequent analysis. Conservation laws are the most versatile, simple and easy to understand description of many phenomena and objects of nature.

The third part of this article is devoted to the specific examples of applications of Combinatorics, Homology and Symmetry to the physical, chemical and biological objects - elementary particles, nuclei of atoms, chemical elements and their ions, molecules and codons. Particular attention is drawn to the need to build a "concentrated" database for the physical, chemical and biological properties.

The fourth part of this article is devoted to the specific examples of the construction of the educational process for children from 4 to 17 years. Displaying what educational tools and how to use them in the formation of the architecture of the process of learning and education.

Key Words: Combinatory, Homology, Symmetry, Teaching Play Rope Playground Equipment.

1. Introduction

It has been over 2140 years since the establishment of the first school in the world - Shishi Middle School, China (143-141 BC).

Throughout this time Education followed the discoveries of science, trying to include more and more information. Expanded only the set of scientific disciplines and the corresponding set of Educational items.

So it can not continue!

The number of hours devoted to lectures and practical classes is limited. It is time to rethink the educational information within each educational subject.

In this way we have to solve three problems:

1. to form a set of academic disciplines himself.
2. to convert each discipline in the form in which an unconscious way familiarity with the subject would be gradually replaced by a more logical and insightful view of information - a Spiral Approach in Education (SAE).
3. to translate educational information systems of the facts into system of principles: knowing some principles easily compensates ignorance of some facts (Claude Adrien Helvétius [1])

In this paper, I will try to identify ways to solving these three problems.

2. Primary system of academic disciplines

Twentieth Century completed chain centuries, during which mankind has discovered and realized the fundamental laws of Nature, comprehend the basic principles of the existence and development of human society. Accumulated a wealth of information in each of the 15 basic areas of knowledge: Linguistics, Literature, Safety, Physical development, Needlework and DIY techniques, Mysticism and religion, Art, Psychology, Sociology and ethics, Statistics, Legislation, Natural science (physics, astronomy, chemistry, biology, geography, ecology), Mathematics, Informatics, History, Economics.

And how should readjust Educational institutions and their programs? How to reorganize the information needed for the study. Which subjects to study in the preschool period, and which only study in school? Do early specialization in training and how should it be built? As early childhood begin methodologically effective engagement in the educational process?

In practice we must build the Spiral Approach in Education (SAE) Process methodologically and scientifically within these 15 vital branches of Knowledge (See Fig. 1 Spiral Approach in Education)

3. Spiral Approach in Education (SAE)

The Spiral Approach [2] can and should be extended to all 15 major disciplines with which children should be instructed from an early age to the graduating class of the school (see. Fig.1).

FOUNDATIONS OF SPIRAL APPROACH TO EDUCATION IN XXI CENTURY

1. Linguistics,
2. Literature,
3. Safety,
4. Physical development,
5. Needlework and DIY techniques,
6. Mysticism and religion,
7. Art,
8. Psychology, sociology and ethics,
9. Statistics,
10. Legislation,
11. Natural science (physics, astronomy, chemistry, biology, geography, ecology),
12. Mathematics,
13. Informatics,
14. History,
15. Economics.

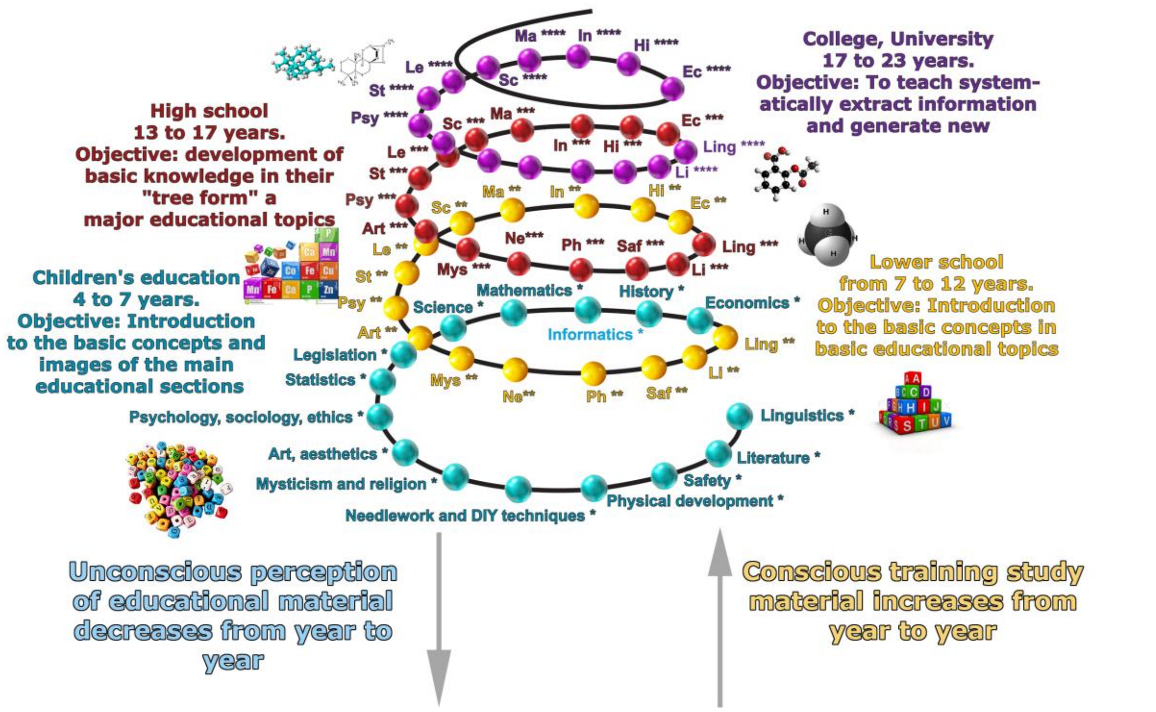


Fig.1. "Educational spiral" - all 15 basic areas of knowledge should be studied children from 4 to 17 years with varying degrees of depth into the subject from year to year. Basic disciplines with (*) relate to early childhood education (preschool cluster), Basic disciplines marked as (**) relate to the educational process in the lower school (lower school cluster). Basic disciplines marked as (***) refer to the educational process in the High school (high school cluster). Followed college cluster (****).Figures on the left and on the right show an example of the gradual transition to when getting acquainted with atoms and molecules.

The spiral approach is a technique often used in teaching or textbooks where first the basic facts of a subject are learned, without worrying about details. For example, for kids - simple pictures without marking items. Then as learning progresses, more and more details are introduced, while at the same time they are related to the basics which are reemphasized many times to help enter them into long-term memory [2].

But most importantly, **in the first place**, it should to seek to spread spiral approach to all 15 basic subject, **secondly**, in the early stages of the educational process, most of the educational tools should be presented as a normal surrounding reality - posters, layouts and working models. At this stage, the child will only remember the images of these educational tools. At subsequent stages of learning these images teacher and (or) parents should explain everything to a deeper level. **Third,** these educational images must be submitted in their evolutionary state.

Why is it important to adopt such a scheme of the educational process?

It reflects the natural learning process. As a child, we first take the book, tear its pages, then stared at the page, then try to understand the signs, letters, words, more words correlate with images and actions, then, with the development, reproduce words, generate new word combinations, etc.

Previously acquainted with a variety of knowledge contributes to early manifestation of talents.

Unfortunately not all 15 basic disciplines were included in the lessons timetable for children. In my opinion, it is wrong approach. These subjects must be learned by children from 4 to 17 years old annually, but with varying degrees of profoundness and detailing from year to year.

The concerns are:

- how to arrange these 15 basic branches one after another and how to fill them during School Educational Process;
- what to choose as fundamental pivotal conception; it is desirable that it should be common for all 15 branches;
- how to use not only "conditional reflex", but perception as well, in a rapid increase of the amount of information, necessary to learn.

To answer these questions, I chose the following organizing principle in Science: **combinatory, homology, symmetry**

4. Combinatory, Homology, Symmetry

4.1.Combinatory

Combinatory is a declassified mathematical apparatus of Nature. Through various permutations and combinations it carried out the selection and adaptation mechanism launched almost all vital installations. Realizing this natural mechanism, scientists have learned to use it in many other fields of knowledge - in physics, chemistry, biology, linguistics, programming ...

No field of knowledge where there could be used to represent combinatory.

No areas of knowledge outside of the natural sciences, where the notion of combinatory are used at very low scientific level.

The main reason is that the vast majority of teachers are beginning to explain the basics of Combinatorics with mathematical formulas and in a limited number of examples [3] and [4]. This approach discourages students. They did not understand the physical interpretation of the physical meaning of combinatorial operations. They only memorize the basic formulas and become opponents of the combinatorial approach to the study of natural phenomena.

Combinatorial principle in its qualitative form of Nature "formulated" for themselves initially (see Fig.2).

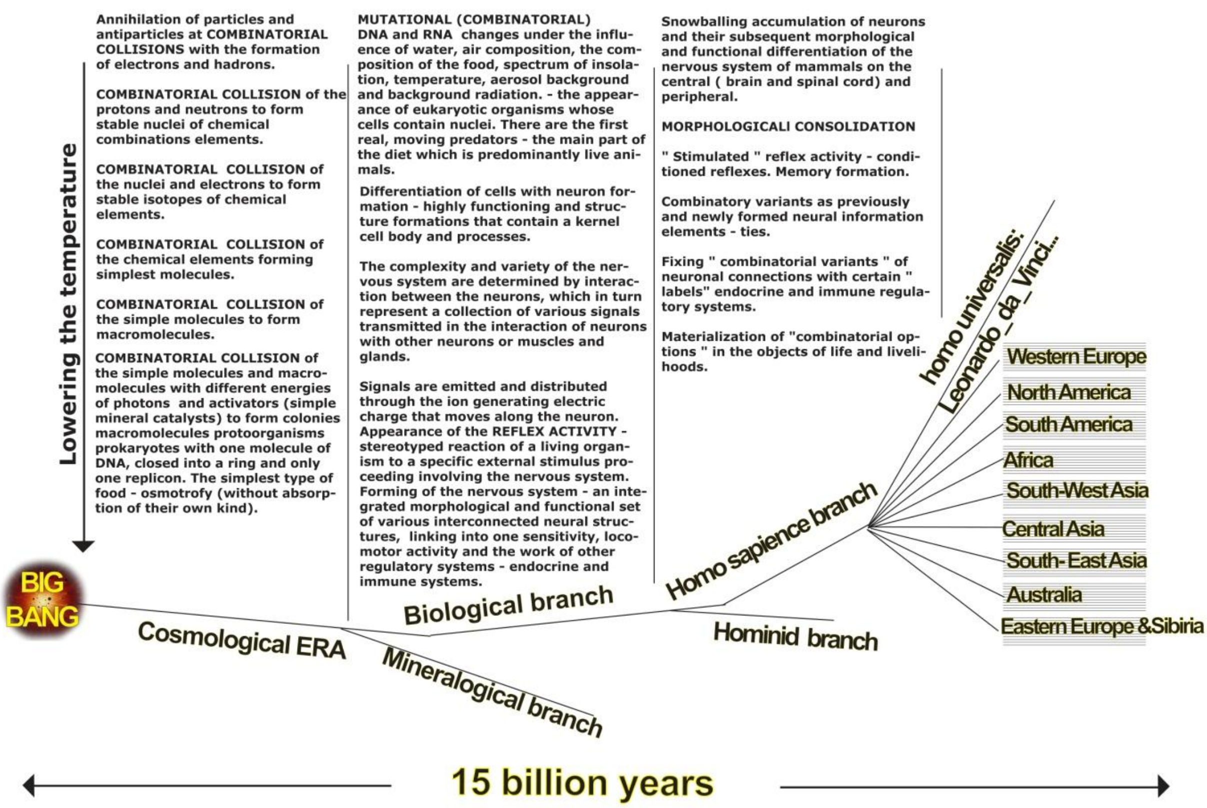


Fig. 2. Combinatorial interpretation processes occurring in our galaxy and in particular in the world during the cooling clot matter after the Big Bang . Here (right) - evolutionary events that took place in Western Europe . Next - evolutionary events in North America , the evolutionary events that took place in South America , the evolutionary events that took place in Africa , the evolutionary events that took place in South-West Asia , evolutionary events , taking place in Central Asia , the evolutionary events in South-East Asia , the evolutionary events that took place in Australia and Islands , the evolutionary events that took place in Eastern Europe and Sibiria.

Much later it was proposed a mathematical interpretation of combinatorial processes.

4.1.1. Graphical interpretation of combinatorial operations

Combinatorial operations have not only the interpretation into the form of formulas. Fig. 3 shows the basic graphic images of combinatorial operations.

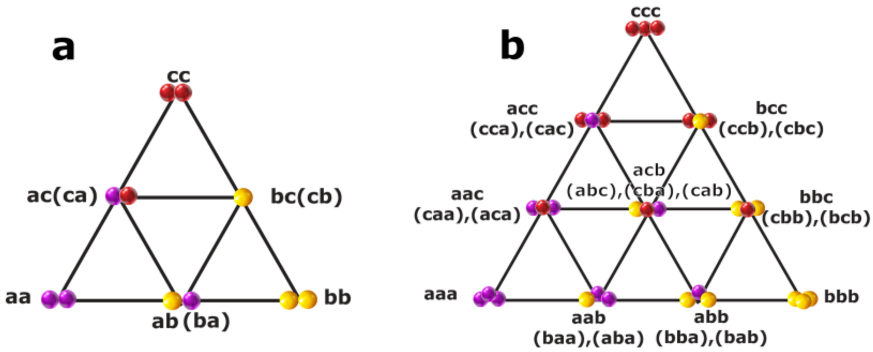


Fig. 3. Illustration of the permutations and combinations of the three elements **a, b, c** to 2 (Fig.3a) and 3 (Fig.3b) with repetitions.

These images bring us closer to understanding the physical and chemical sense combinatorial operations - a set of homologous series.

Note the regular arrangement of homologous series, which correspond to the replacement of one element of a combinatorial object to another element to form a new combinatorial object.,

4.2. Homology and Analogy

The concept of "homology" and "analogy" one of the most popular in the academic world (homology) and in everyday life (analogy). These terms are the initial concepts of comparative analysis.

4.2.1. Homology and homologous series

However, if we go back to the original, Greek meaning (**Dictionaries give only the translation: Homology (al-Greek.. μοιος - like, similar (?); λογος - word, law, reason, sense),** we need to understand what is "almost the same object" and answer the question: is it possible to assess the level of this "almost"?

Let:

1. **a,b,c - a fixed number of elements** for which may be applied combinatorial operations.
2. **a,b,c** - elements having at least **one common and essential for them characteristic** to form the compounds (a set of quarks, nucleons, the same structure of the outer electron shell, etc.)
3. in the transition from compound to compound, **the only one element is replaced**: **a - b**, **a - c**, **b - c.**
4. resulting compounds constitute **a group of objects, united, at least one essential characteristic for this group** (e.g., the same spin baryons, one and the same point group (geometric) of symmetry of molecules, a single functional unit - codon (in the construction DNA and RNA).
5. resulting compounds constitute a **group of objects, united under the combinatorial operation** - a permutation or combination.

If these conditions are met, then a set of abstract elements of **a, b, c, d, e** .... transformed into a set of physically meaningful homologous series (see. Fig. 4, 5,6,7,8,9).

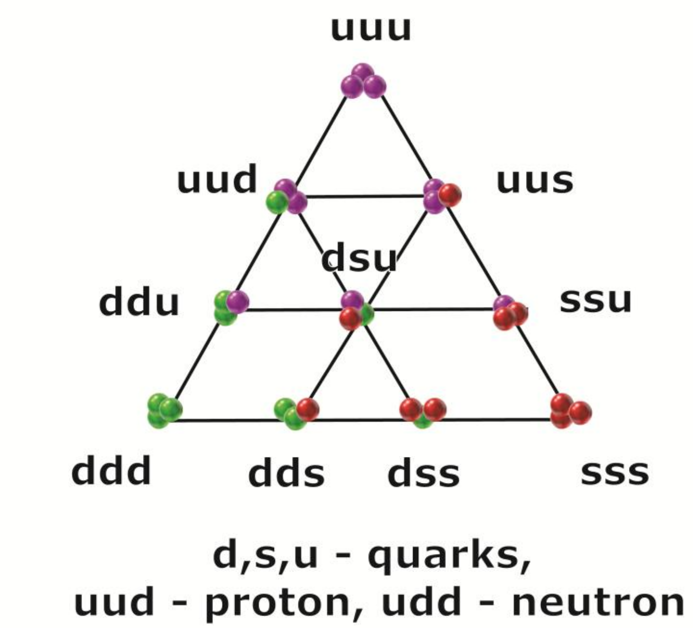


Fig.4. Combinations of three **u, d**, **s** quarks forming baryons with a spin $-{}^{3}/_{2}$ form the **uds** baryon decuplet [5]

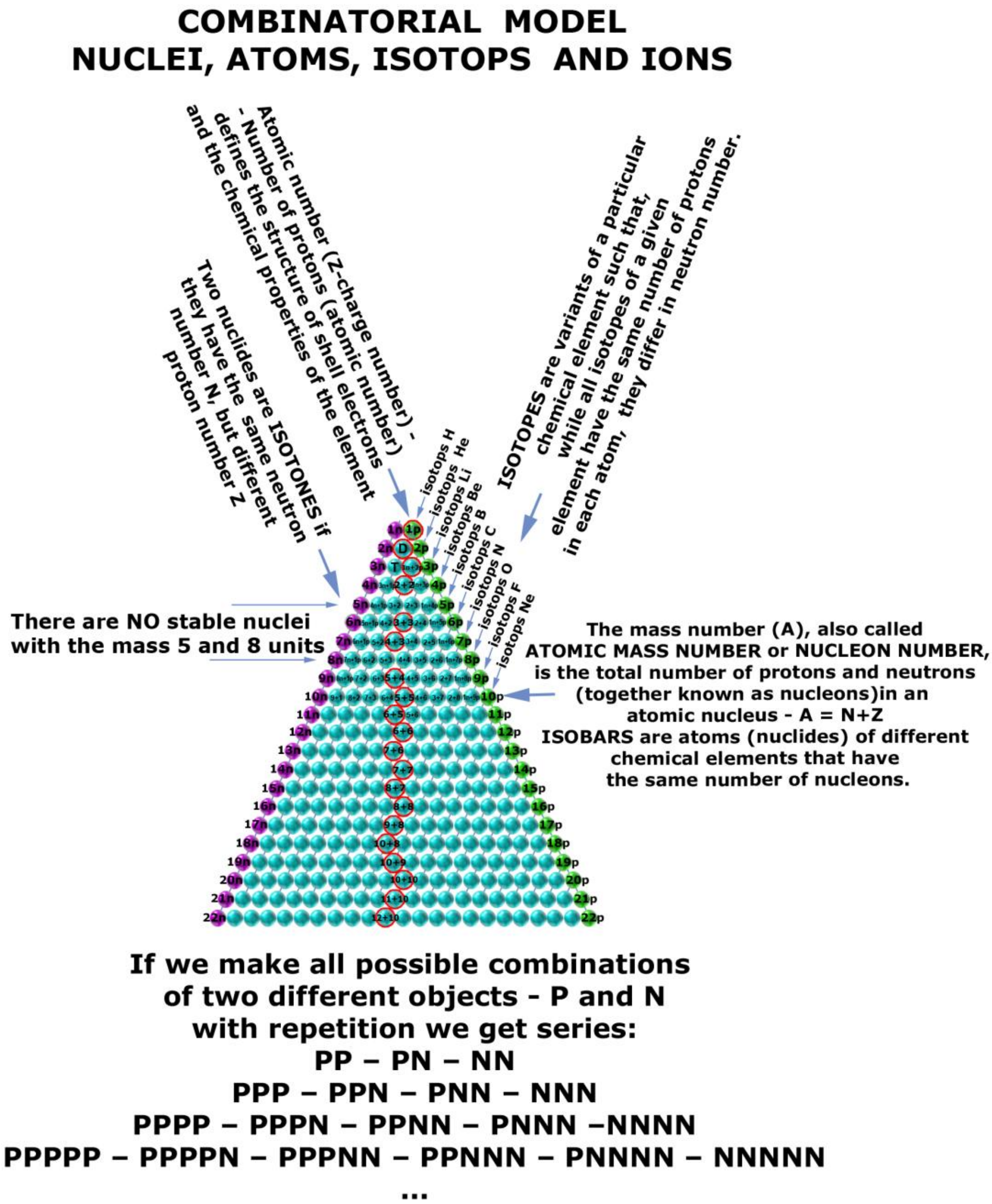


Fig. 5. Frame of nuclei of chemical elements, chemical elements themselves, and their isotope and ions. Red circled stable isotopes. Homologous series, as defined above, are only isobars. Isotopes and isotones are analogues.

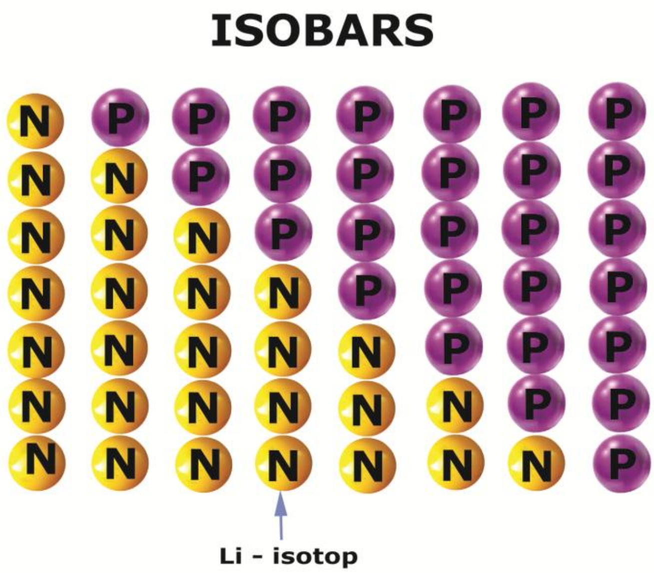


Fig.6. True homologous series - ISOBARS - the number of nucleotides is the fixed number

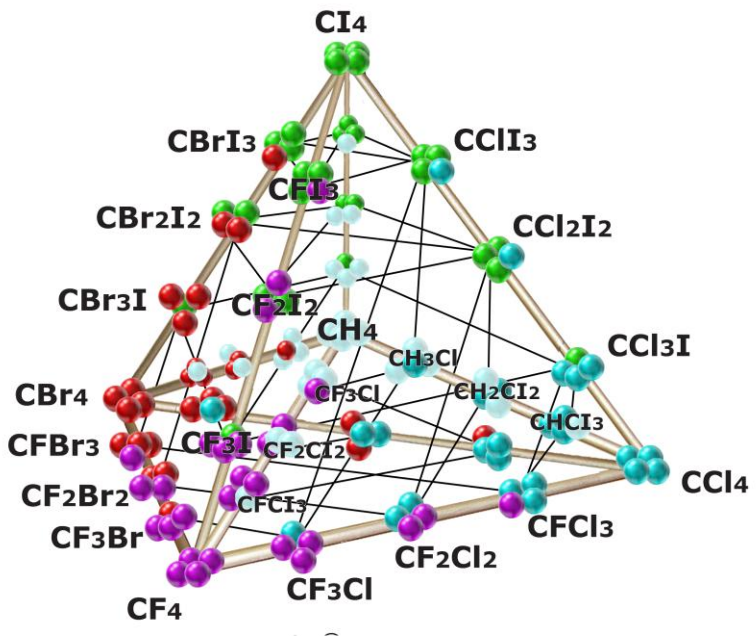


Fig. 7. The illustration of all possible combinations of 5 different objects (H,F,Cl,Br,I) with 4 repetitions. Building such a structure allows for more intuitive form to submit a combinatorial nature, such as the family of halogenated methanes.

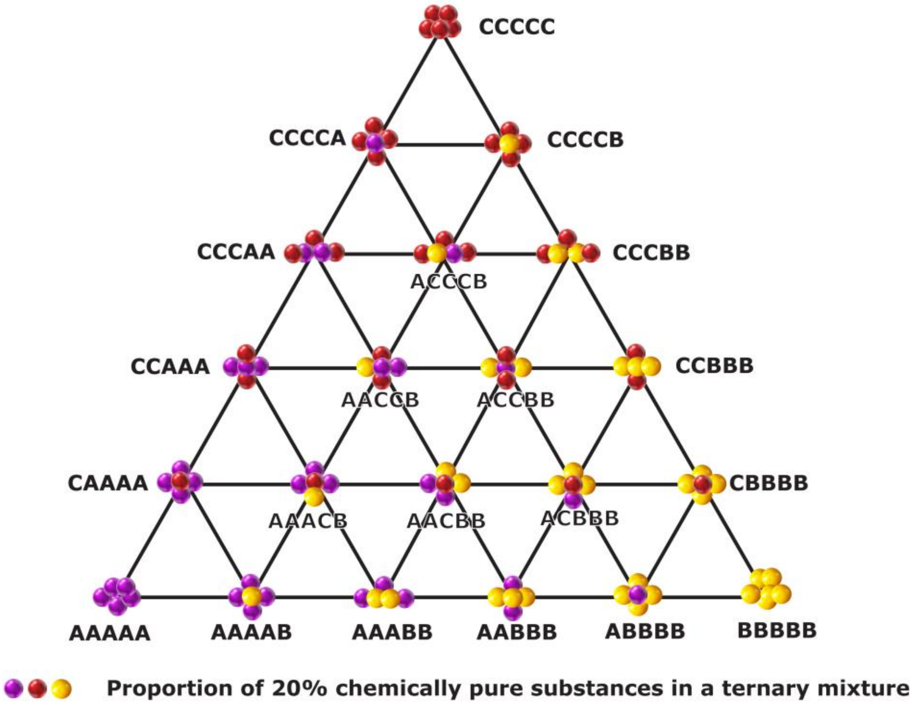


Fig.8. True homologous series - three different chemically pure substance (A, B, C) in the same phase state in the same temperature and under constant pressure. Substances are not chemically interact. Shown a mixture with 20% equity step.

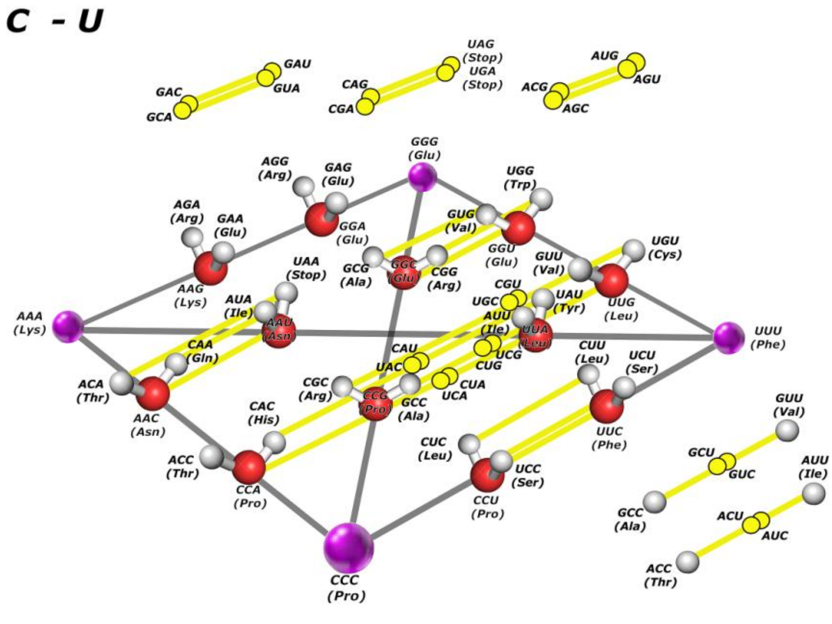


Fig.9. The formal structure of homologous series of codons. Codons, specify which amino acid (in brackets) will be added next during protein synthesis. Yellow lines show the "related" transitions from one codon to another codon while replacing (C - U).

4.2.2. Analogs and analogs series

The analogy comes from Greek. **Αναλογία «line", from ανά «on, according to» + λόγος «word, law, reason, sense“).** In other words - "the object looks like another object." This raises two questions: what is the "object" and that means "like"?

Assume that one object is composed of items**: n, n, n, n, n, p**, and another object is composed of elements **n, n, n, n, n, p, p**. These two objects are composed of qualitatively the same set of elements (in this case - the protons and neutrons (See. Fig. 5).

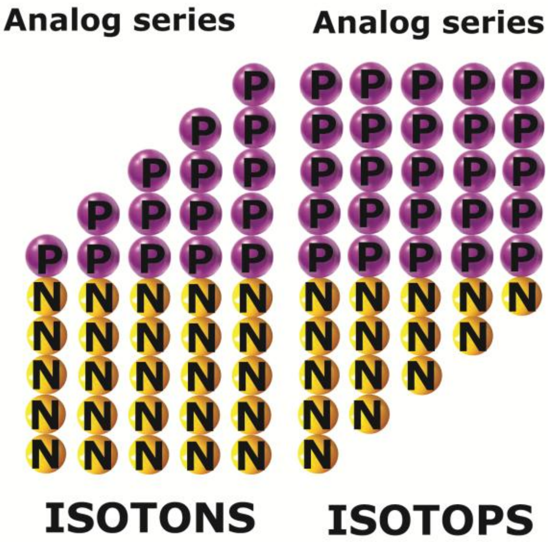


Fig.10. Nucleus analogues - isotons, isotopes and their series. Isotons similar because they contain the same number of neutrons, while the isotopes are similar in that they contain the same number of protons. Both sets form the corresponding series of analogs

Another example. Molecules CH3 H, CH3 CH3, CH3 CH3 CH2 etc. qualitatively similar to each other, since they consist of carbon and hydrogen. And they are similar due to an extra methylene bridge (-CH2- unit) inserted in the chain (see. Fig.11).

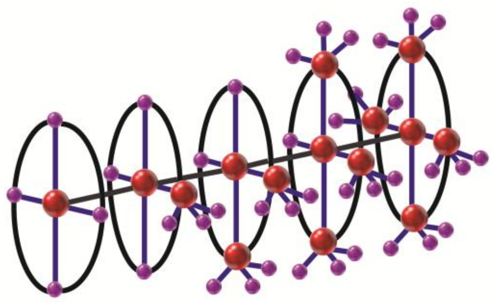


Fig.11. A series of analogues of saturated hydrocarbons. Strictly speaking, the a series of C_nH_{2n+2} is not homology.

When going from one compound to another, changes not only number of its constituent atoms, but also a group of geometric symmetry. It means that the dependence of physical or chemical parameters for a series of molecules will carry the shape of a complex function of the number of ligands.

The following example of the Analogy refers to biochemistry and genetics. Thymine, Uracile, Cytosine, Guanine and Adenine are the four main nucleobases found in the nucleic acids DNA and RNA (see Fig.12).

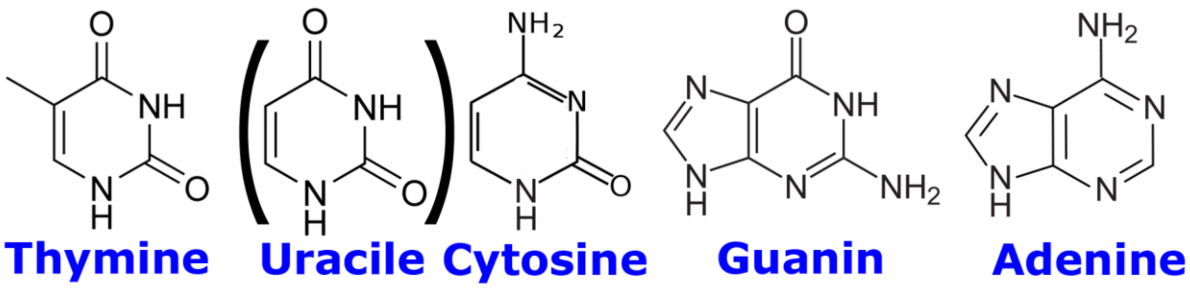


Fig.12. This is series of analogs. The principal part for comparative analysis may be a benzene ring. In DNA, the uracil nucleobase is replaced by thymine. Uracil could be considered a demethylated form of thymine.

So analogues are objects whose:

1. at least one element of each object has a similar structure and performs similar functions. (the robot arm and the hand of man).
2. the number of elements included in the object may be different. This implies that compared objects belong to different combinatorial sets both within the same class (permutation or combination), and within the number of combinable elements.

It is obvious that inaccurate adherence to the above definitions not only leads to erroneous images Homology and Analogy in the educational process, but also deprives these images further rigorous mathematical analysis. Currently, the "idea of homology" is used in mathematics (Homology theory, Homological algebra), biology (Homologous chromosomes, Homology modeling, Homologous recombination, Homologous desensitization), chemistry (Homologous series, Homologous relationship, Homologation reaction), sociology, psychology, anthropology.

And only in mathematics these ideas are presented in a strict form. It should be noted that this form is far from majority of scholars understanding who faraway from mathematics.

4.3. Symmetry. Two main types of symmetries

A fundamental property of objects of material nature is the property to retain its shape and forms of interaction with each other after certain discrete transformations (rotation, reflection, the substitution of one element of the object to another one) over them in a variety of closed real (space-time) and abstract (phase transformations in an abstract space quantum-mechanical operators and vectors) spaces.

This property is called symmetry.

Symmetry is a universal quality of objects of nature, manifested both in their structure and the process of their interaction. The presence of symmetry makes it easy (not doing complex calculations) to find a simple equation for calculating the parameters of the objects as well as parameters of the processes of their interaction.

But the most important property of the objects of nature itself is not even the symmetry of the object. In nature, a very are rarely found strictly symmetrical objects. Important are the types and causes of violations of the symmetry in the real world. For example, the asymmetry of the trees in the northern latitudes shows the uneven insolation during daytime.

4.3.1. Symmetry in geometric space

Operations on the object, leading to a complete match of the original object and its Reformed image is called a symmetry operation.

Consider the elements **a, b, c... .** They represent microparticles of a certain body. Choose a simple operation - the transfer of each of **i** particles with coordinates ($\mathbf{x_i, y_i, z_i}$) to a distance **(**$\mathbf{-x_i , -y_i , -z_i}$) we obtain the **symmetry operation - reflection** with respect to plane, located in the zero coordinates. The plane itself is called an element of symmetry (in this case it is **a plane of symmetry**)

In this case the symmetry appears in a form of distance equations in terms of the coordinates ($\mathbf{x_i, y_i, z_i}$) up to the plane and the points with coordinates **(**$\mathbf{-x_i , -y_i , -z_i}$) to the same plane. (see Fig. 13):

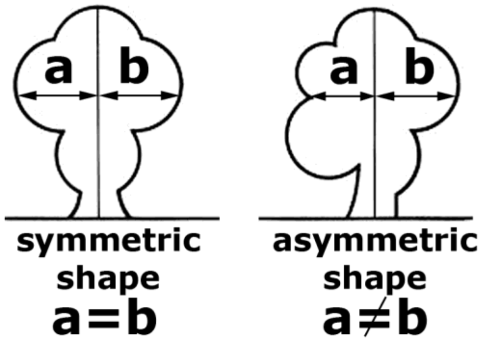


Fig.13. This is an example of the geometric symmetry - shape retention upon reflection of one half of the object in the plane The **conservation law of the <u>form</u> of the object** "A" for the case of reflection in the plane is:

$$A_i(\mathbf{x_i, y_i, z_i}) - A_p\,(0,0,0) = A_p\,(0,0,0) - A_i(\mathbf{-x_i , -y_i , -z_i})$$

It is known that there are many different elements of symmetry and the corresponding symmetry operations. Combining symmetry operations applied to a single object forms a **group of the symmetry operations**.

In some complex cases of symmetry the process of finding the law of conservation becomes complicated mathematical problem.

4.3.2. Symmetry in the parameter space

Consider the case where the "body" is an object consisting of a finite number of particles **(a, b, c).**

In the case of an object consisting of a set of (**a, b, c**) the role of "a plurality of microparticles " plays the combinatorial set presented in Fig. 3. But in this case the operation "microparticles transfer" is one of the replacements (**a - b, a - c, b - c**).

In case of replacement (**a - b**) new objects as follows (set of transitions 1):

aaa - aab - abb - bbb
aac - abc - bbc
acc - bcc

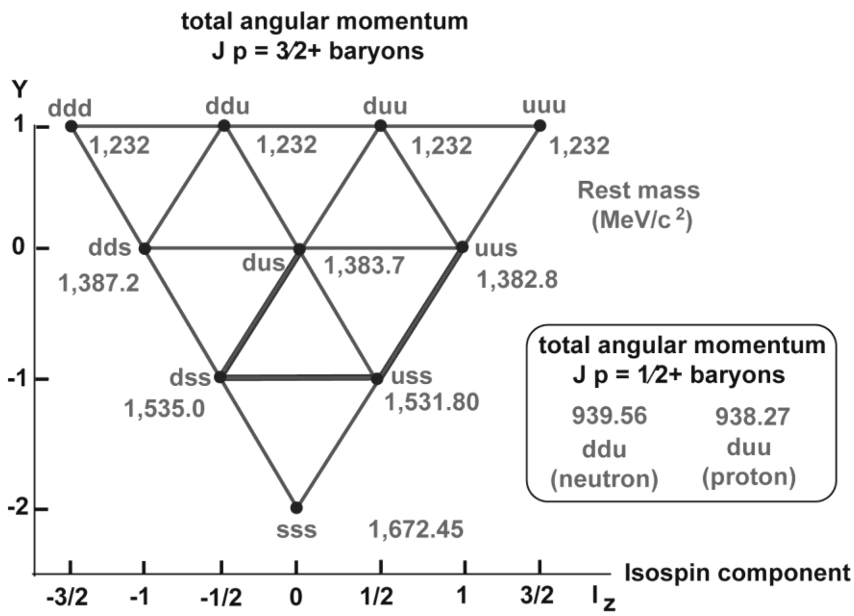
Of course, in this case the object **aaa** is not identical the object **aab**, the object **abb**, or object **bbb**.

In the case of a "combinatorial symmetry", replacing one element in the "combinatorial compound" **(a)** by another element **(b)** we obtain another "combinatorial compound" of the whole set of combinatorial compounds **a, b, c ...** (obtained using combinations or permutations).

Applying this operation to each compound of the set in question we can obtain a set of transitions. Absolutely identical (in theory) in this case is the distance between the source and re-derived compounds in the space of their physical or chemical parameters.

So it may be identical the change of a certain physical parameter ***A*** at transformation one object to another (e.g. when replacing **a** to **b**): ***A* (aab) - *A* (abb) = *A* (abc) - *A* (bbc).**

The case when the set of (**a, b, c**) is a set of quarks (**u, d, s**) is presented in Fig.14.



SYMMETRIC RATIO:

RM(dss) - RM(dus) = RM(uss) - RM(uus)

ASYMMETRIC RATIO:

RM(dss) - RM(dus) ≠ RM(dss) - RM(uus)

Fig.14. Unitary (or as I call it "parametric" symmetry) is the preservation of the ratio distribution of objects in the space of parameters by replacing one component to another component of the object. Conservation law in this case is the same (unitary) for objects of different nature. From elementary particles up to ...

And it repeatedly confirmed both experimentally and theoretically [6], [7], [8],[9],[10],[11],

This type of identity is called unitary symmetry and denoted **SU (n)**, where **n** - number of elements from which the object is collected.

Very important quality of unitary symmetry is its universality. Under the set (**a, b, c**) can be understood as a set of quark (**u, d, s**), set of protons and neutrons (**p, n**), a set of atoms (e.g., **F, Cl, Br**), a set of nitrogenous bases **A, G, C, T** or , **A,G, C, U**, a set of **20 amino acids**, **a set percentage of the components in the mixture** (e.g., 20% **A**, 20% **B**, 20% **C**).

So this is applicable to a variety of combinatorial objects animate and inanimate nature.

Another important advantage of Unitary Symmetry is the simplicity of the equations themselves and calculation procedures.

4.3.2.1. Examples of practical use of Unitary Symmetry

4.3.2.1.1. Invariability of the ratio of the ionization energies of atoms.

Consider the combination of a repetition of a proton and a neutron - two by two, two by three, two by four, etc. Together with a single proton and a corresponding number of electrons, we obtain a set of atoms (see. Fig.5).

We analyze the ionization potentials of the first 20 atoms [12]. Input data is presented in Table. 1 and in Fig. 15, 16, 17.

Table 1. Regularities in the ionization potentials and their differences for chemical elements with Z = 1 - 20 To save space, the designation of the ionization potential (I_i) to the atoms in the 4 and 5 columns are omitted.

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Table 1

The number of protons, the nuclear charge Z	atom	Ionization potentials (I) of the $1s^1$ electron. (eV)	The difference between the ionization potentials of the $1s^1$ electron of two neighboring elements. (eV)		The difference between the differences of ionization potentials for the $1s^1$ electrons for two neighboring groups of atoms – $-[I_i(A_Z) - I_i(A_{Z+1})] - [I_i(A_{Z+1}) - I_i(A_{Z+2})]$, (eV)	
1	H	13,598				
			(H-He)	40,818		
2	He	54,416			(H-He) - (He-Li)	27,217
			(He-Li)	68,035		
3	Li	122,451			(He-Li) - (Li - Be)	27,227
			(Li-Be)	95,262		
4	Be	217,713			(Li-Be) - (Be - B)	27,242
			(Be-B)	122,504		
5	B	340,217			(Be-B) - (B-C)	26,360
			(B-C)	148,864		
6	C	489,081			(B-C) - (C-N)	29,084
			(C-N)	177,948		
7	N	667,029			(C-N) - (N-O)	26,410
			(N-O)	204,358		
8	O	871,387			(N-O) - (O-F)	27,344
			(O-F)	231,702		
9	F	1103,089			(O-F) - (F-Ne)	27,373
			(F-Ne)	259,075		
10	Ne	1362,164			(F-Ne) - (Ne-Na)	27,420
			(Ne-Na)	286,495		
11	Na	1648,659			(Ne-Na) - (Na-Mg)	27,459
			(Na-Mg)	313,954		
12	Mg	1962,613			(Na-Mg) - (Mg-Al)	27,513
			(Mg-Al)	341,467		
13	Al	2304,080			(Mg-Al) - (Al-Si)	27,561
			(Al-Si)	369,028		
14	Si	2673,108			(Al-Si) - (Si-P)	27,626
			(Si-P)	396,654		
15	P	3069,762			(Si-P) - (P-S)	27,683
			(P-S)	424,337		
16	S	3494,099			(P-S) - (S-Cl)	27,757
			(S-Cl)	452,094		
17	Cl	3946,193			(S-Cl) - (Cl-Ar)	27,827
			(Cl-Ar)	479,921		
18	Ar	4426,114			(Cl-Ar) - (Ar-K)	27,896
			(Ar-K)	507,817		
19	K	4933,931			(Ar-K) - (K-Ca)	27,990
			(K-Ca)	535,807		
20	Ca	5469,738				

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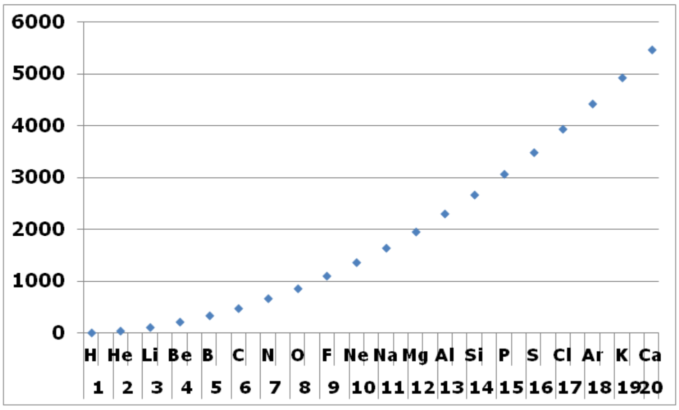

Fig 15. Ionisation Energies (eV) of $1s^1$ electrons vs Z for atoms Z = 1 - 20

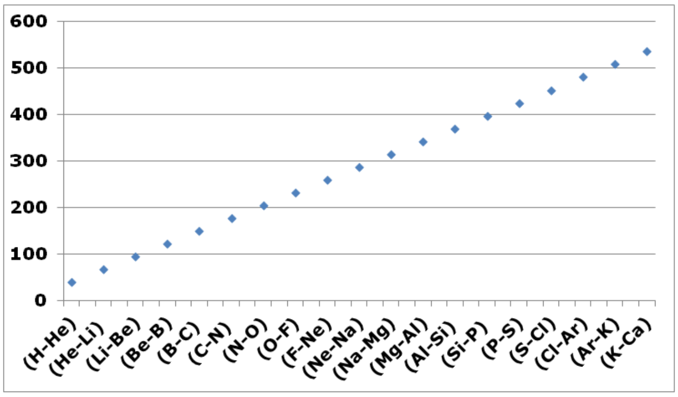

Fig.16. The Ionisation Energies difference between the values of the $1s^1$ electron of two neiboring elements - $[I_i (A_Z) - I_i(A_{Z+1})]$, (eV)

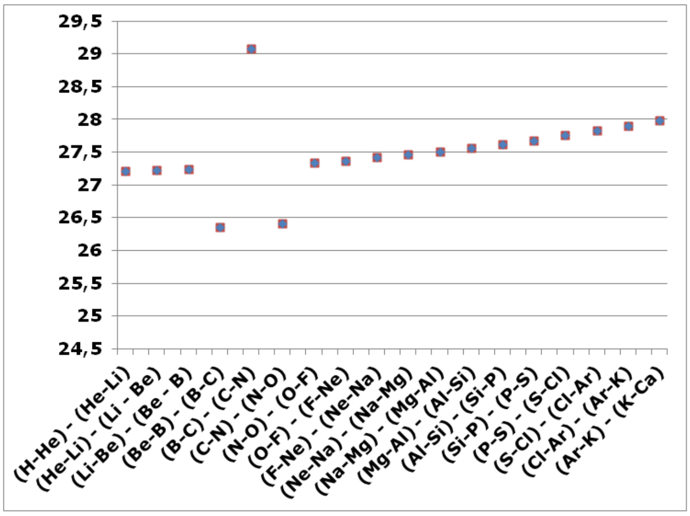

Fig.17. The Ionisation Energies difference between the values of the $1s^1$ electron of two groups of the neiboring elements - $[I_i (A_Z) - I_i(A_{Z+1})] - [I_i (A_{Z+1}) - I_i (A_{Z+2})]$, (eV)

As can be seen from the Fig. 17 from the almost linear dependence:

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$[I_i\,(A_Z) - I_i(A_{Z+1})] - [I_i\,(A_{Z+1}) - I_i\,(A_{Z+2})]$ vs $[Z_i\,(A_Z) - Z_i(A_{Z+1})] - [Z_i\,(A_{Z+1}) - Z_i\,(A_{Z+2})]$

drop out the point which corresponds to the difference of the ionization energies for the elements Be, B, C, N and O

$$\{[I(Be) - I(B)] - [I(B) - I(C)]\},$$

$$\{[I(B) - I(C)] - [I(C) - I(N)]\},$$

$$\{[I(C) - I(N)] - [I(N) - I(O)]\}$$

If we carry out a similar analysis for the ionization energies of all the other electrons, we shall find that

$$[I_i\,(A_Z) - I_i(A_{Z+1})] - [I_i\,(A_{Z+1}) - I_i\,(A_{Z+2})] = const$$

where I_i - ionization energy of (i) electron of the atom A_Z with atomic number Z.

Moreover irregularities were identified for the following values as well:

$\{[I(S) - I(Cl)] - [I(Cl) - I(Ar]\}$ and $\{[I(Cl) - I(Ar)] - [I(Ar) - I(K)]\}$ - **($1S^2 2S^1$ electron)**

$\{[I(Cl) - I(Ar)] - [I(Ar) - I(K]\}$ and $\{[I(Ar) - I(K)] - [I(K) - I(Ca)]\}$ - **($1S^2 2S^2$ electron)**

$\{[I(Na) - I(Mg)] - [I(Mg) - I(Al]\}$ and $\{[I(Mg) - I(Al)] - [I(Al) - I(Si)]\}$ and $\{[I(Al) - I(Si)] -$

$-[I(Si) – I(P)]\}$ - **($1S^2 2S^2\, 2P^1$ electron)**

$\{[I(Ne) - I(Na)] - [I(Na) - I(Mg]\}$, $\{[I(Na) - I(Mg)] - [I(Mg) - I(Al)]\}$ and $\{[I(Mg) - I(Al)] -$

$-[I(Al) - I(Si)]\}$ - **($1S^2 2S^2\, 2P^2$ electron)**

$\{[I(N) - I(O)] - [I(O) - I(F]\}$ and $\{[I(F) - I(Ne)] - [I(Ne) - I(Na)]\}$- **($1S^2 2S^2\, 2P^3$ electron)**

To conclude this section we would like to note that it is not difficult to find such regularities of the other physical and chemical properties of atoms and ions and create a significant Self consistent database (SCD).

4.3.2.2. The law of conservation of relations of the physical parameters of isostructural of isovalent of substituted molecules.

The formal structure of a homologous series for halogen methanes presented in Fig. 7.

It was shown [6],[7] [8], [9] that making certain symmetry operations in the space of physical parameters of the elements of the set of halogenated methane traced constancy of the parameter in the difference in specific transitions from one compound to another. That is, there is almost the same pattern as in the systematics of baryons, which Gell-Mann pointed out in [5].

Placing the system of the homologous series of halogenated methanes in the space of physical and chemical parameters, we can obtain a distribution with great predictive power. The results are discussed in terms of first-principles of the symmetry influence to the core-ionization energies and to thermochemical parameters. The value of Vertical Ionization Energies [13] is illustrated in Fig.18.

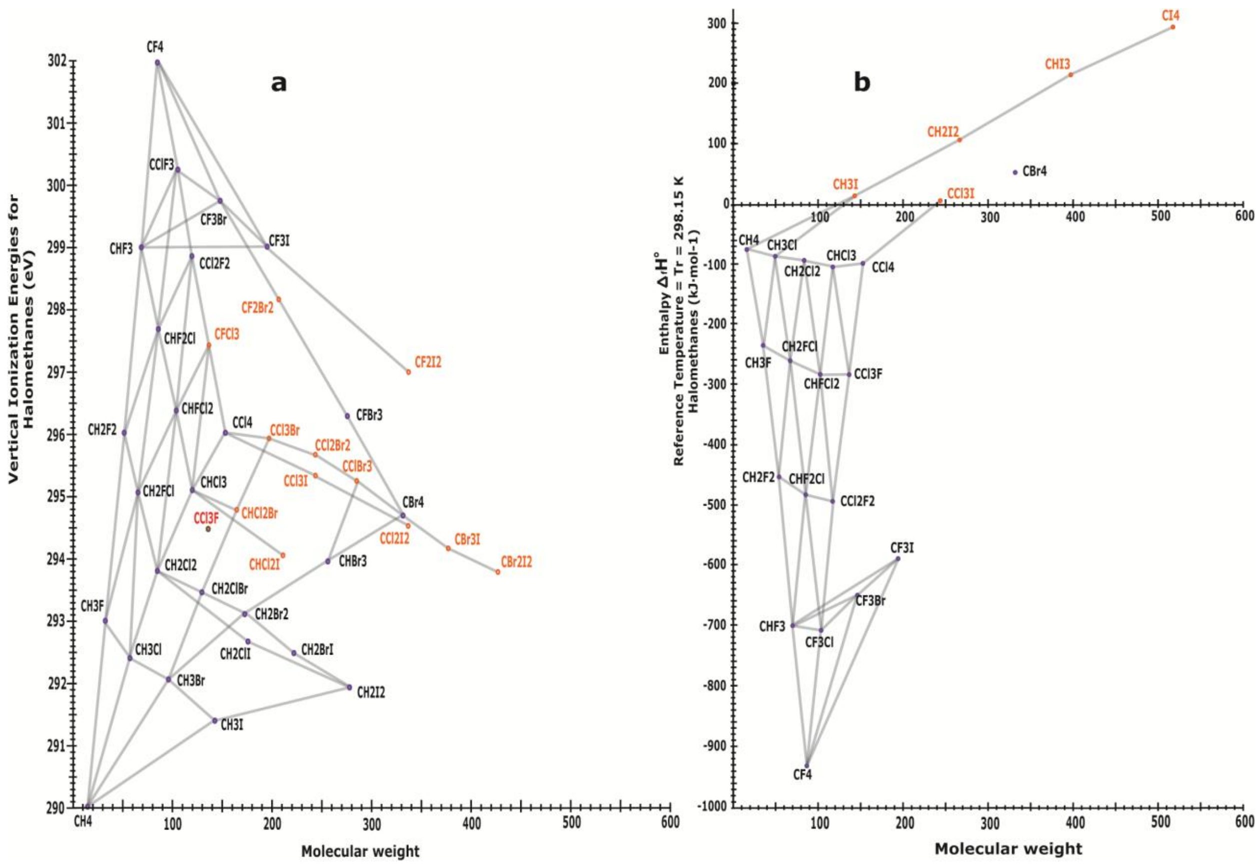

Fig.18a.Vertical Ionization Energies (VIE - I_{VIE}) and Enthalpy ΔH_f^o. of halogenated methanes v.s. on their molecular weight. Black letters and blue dots indicate the compounds listed in [13] (for I_{VIE}). Orange color compounds and their values (VIE), the resulting calculations similar to those of Table 2. Red marked compound CFCl3, which in [13] is erroneous.

Fig.18b. Black letters and blue dots indicate ΔH_f^o for compounds listed in [14]. Orange color compounds and their values (VIE) is the resulting calculations of ΔH_f^o [14]. The value ΔH_f^o (CICl3) is the result of calculations similar to those of Table 2.

For the entire class of halogenated methanes $CH_{4-n-m} X_n Y_m$ (X,Y = F,Cl,Br,I) in accordance with the combinatorial substituting one atom to another for combinations (${}^{n-1}C_{n+k-1} = (n+k-1)! / k!(n-1)!$, where n = 5, k = 2 - "n choose k") can be obtained the total amount of substituting (10): F - H, F - Cl, F - Br, F - I, Cl - H, Cl - Br, Cl - I, Br - H, Br - I, I - H. For each substitution is made 9 basic equations of conservation of the difference (I_{VIE}) for molecules with the same geometric symmetry operations groups . The total number of basic equations is 90. Below is a table of equations to replace the F - H.

Table 2. The system of equations for the replacement F-H. Before each chemical compound formula omitted designation (I_{VIE}) in order to save space. Blue marked data have been cited in [13] (see Table. 1, [13]). Red marked values (I_{VIE}) calculated based on the data (see Table 1, [13]). In Equation 7 clearly shows the consequences of an erroneous value for CFCl3. New value (I_{VIE}) for CFCl3, as reported to me one of the authors [13] is 297.48 eV.

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		.Replacement: F ⟷ H			
		The law of conservation within the same point group symmetry - C_{3v} or C_s The highest degree of accuracy			
1	CF3Cl - CF3Br	= 0,48	(C_{3v}) ~	= 0,374	CH3Cl - CH3Br
	300,25 - 299,77				292,43 - 292,056
1a		CHF2Cl - CHF2Br =	(C_s)	= CH2FCl - CH2FBr	
		297.700 - ( )	~	295.036 - ( )	
2	CF3Br - CF3I	= 0,77	(C_{3v}) ~	= 0,626	CH3Br - CH3I
	299,77 - 299,00				292,056 - 291,43
2a		CHF2Br - CHF2I =	(C_s)	= CH2FBr - CH2FI	
		( ) - ( )	~	( ) - ( )	
3	CF3Cl - CF3I	= 1,25	(C_{3v}) ~	= 1,00	CH3Cl - CH3I
	300,25 - 299,00				292,43 - 291,43
3a		CHF2Cl - CHF2I =	(C_s)	CH2FCl - CH2FI	
		297.700 - ( )	~	295.036 - ( )	
		The law of conservation within the same point group symmetry - C_{2v} The highest degree of accuracy			
4	CF2Cl2 - CF2Br2	= 0,709	(C_{2v}) =	= 0,709	CH2Cl2 - CH2Br2
	298,87 - 298,161				293,81 - 293,101
		CHFCl2 - CHFBr2			
		296,372 - ( ) (C_s)			
5	CF2Cl2 - CF2I2	= 1.827	(C_{2v}) =	= 1.827	CH2Cl2 - CH2I2
	298,87 - 297,043				293,81 - 291,983
		CHFCl2 - CHFI2			
		296,372 - ( ) (C_s)			
6	CF2Br2 - CF2I2	= 1,118	(C_{2v}) =	= 1,118	CH2Br2 - CH2I2
	298,161 - 297,043				293,101 - 291,983
		CHFBr2 - CHFI2			
		( ) - ( ) (C_s)			
		The law of conservation within the same point group symmetry - C_{3v} The highest degree of accuracy			
7	CFCl3 - CFBr3	= 1,169 (- 1,796)	(C_{3v}) =	= 1,169	CHCl3 - CHBr3
	297,445 (294.48) - 296,276				295,16 - 293,991
8	CFBr3 - CFI3	=	(C_{3v})	=	CHBr3 - CHI3
	296,276 - ( )				293,991- ( )
9	CFI3 - CFCl3	=	(C_{3v})	=	CHI3 - CHCl3
	( ) - 297,445 (294,48)				( ) - 295,16

In the particular case (see Table 2) row 1 is to be written in the form:

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$$I_{VIE}(CF3Cl) - I_{VIE}(CF3Br) = I_{VIE}(CH3Cl) - I_{VIE}(CH3Br)$$
$$I_{VIE}(CHF2Cl) - I_{VIE}(CHF2Br) = I_{VIE}(CH2FCl) - I_{VIE}(CH2FBr)$$

where I_{VIE} is Vertical Ionization Energies.

Thanks isovalent substitution and the same point (geometric) symmetry of the molecules in each of the equations, these equations are almost the exact equations.

For some other parameters, where the geometric symmetry of the molecules does not have a noticeable effect on the studied parameter (e.g. enthalpy of formation), the above equation can be written as follows:

$$I_{VIE}(CF3Cl) - I_{VIE}(CF3Br) = I_{VIE}(CH3Cl) - I_{VIE}(CH3Br) =(!)$$
$$(!)=I_{VIE}(CHF2Cl) - I_{VIE}(CHF2Br) = I_{VIE}(CH2FCl) - I_{VIE}(CH2FBr)$$

For the more general case in Table 2 should be a sign for the approximate equality (~) !.

The same applies to all of the equations in Table 2 and the rest of 81 equations for other isovalent substitution of one atom of a molecule to another atom.

Solving this system of 90 equations, substituting them reliable experimental data (highlighted in blue), you can easily find a self-consistent in the selected set of molecules, the values of the unknown parameter.

According to [13] with the whole set of equations to obtain new values (I_{VIE}) for the following molecules : CF2I2 (297,043), CCl2I2 (294,507), CF2Br2 (298,161), CFCl3 (297,445), CCl3Br (295,944), CCl3I (295,318) , CCl2Br2 (295,625), CClBr3, 295,241, CBr3I (294,149), CBr2I2 (293,798), CHCl2I (294,032), CHCl2Br (294,792).

Similar calculations were carried out for the thermo chemical parameters of halogenated methanes. However, the data presented in [14] are so irrational in terms of following dependence of the enthalpy of the geometric symmetry of the molecules (see Fig.18b) that either should increase measurement error, or use simple additive schemes.

Everything in this case, sufficient reliability can be done using this equation

$$\Delta H_f^o(\mathbf{CIF3}) - \Delta H_f^o(\mathbf{CICl3}) = \Delta H_f^o(\mathbf{CHF3}) - \Delta H_f^o(\mathbf{CHCl3})$$

is to determine $\Delta H_f^o(\mathbf{CICl3}) = 4,77\ \mathrm{kJ\ mol}^{-1}$

4.3.2.3. Combinatorics of nitrogenous bases and codons. The homology of "related" mutation

It is known that from the total number of complex molecules the most important in terms of self-perpetuation spun polymer chains of nitrogenous bases - adenine (A), guanine (G), thymine (T), cytosine (C), uracil (U). Wherein the set of A, G, C, T - forms a DNA polymer, and the set of A, G, C, U polymer of RNA forms.

It turned out that 64 three nitrogenous bases completely "cover" all the vital for the synthesis of protein 20 amino acids.

Let us recall that codon (encoding trinucleotide) is a unit of the genetic code, nucleotide residues triplet (t) in the DNA or RNA, typically encoding a protein including one amino acid. The sequence of of codons in the gene determines the sequence of amino acids in the polypeptide chain of the protein encoded by this gene.

What happens if, for whatever reason, on-site, such as CCA codon in the gene would UCA codon or codon CUA?

Note that genes are portions of DNA carrying any comprehensive information about the structure of a protein molecule or a RNA molecule. These and other functional molecules determine the development, growth and functioning of the body. Apparently, should change and protein molecule which is responsible for. In other words, if in place of a codon CCA, encoding a protein including the amino acid Pro (Proline), appears codon UCA, then in a protein will appear not proline and Ser (Serine). And in the case of on-site codon CCA will appear another codon - CUA, then in a protein will appeare an amino acid Leu (Leucine).

How will this affect the development, growth and functioning of the body?

But there are other options. For example, if at the location of codon AGC in a gene the codon AGU, will appear then on protein synthesis such replacement does not affect - in both cases in the protein will be enabled the amino acid Ser (Serine).

According to the combinatorial rule in the case of codons it is possible to produce 6 substitutions of one nitrogenous base to another base. For the RNA bases - A,G,C,U these substitutions are: C-U, C-G, C-A, G-U, G-A, A-U.

Formal systems of RNA homologous series, following combinatorial and homological representations can be constructed as shown in Fig.9.

The system of all the possible homology to replace C - U shown in Table 3.

Table 3. All possible codons homology when replacing the C - U. The red arrows indicate the substitution of one codon to another, in which the synthesized amino acid changes. The blue arrows indicate the substitution of one codon to another, in which the synthesized acid remains unchanged.

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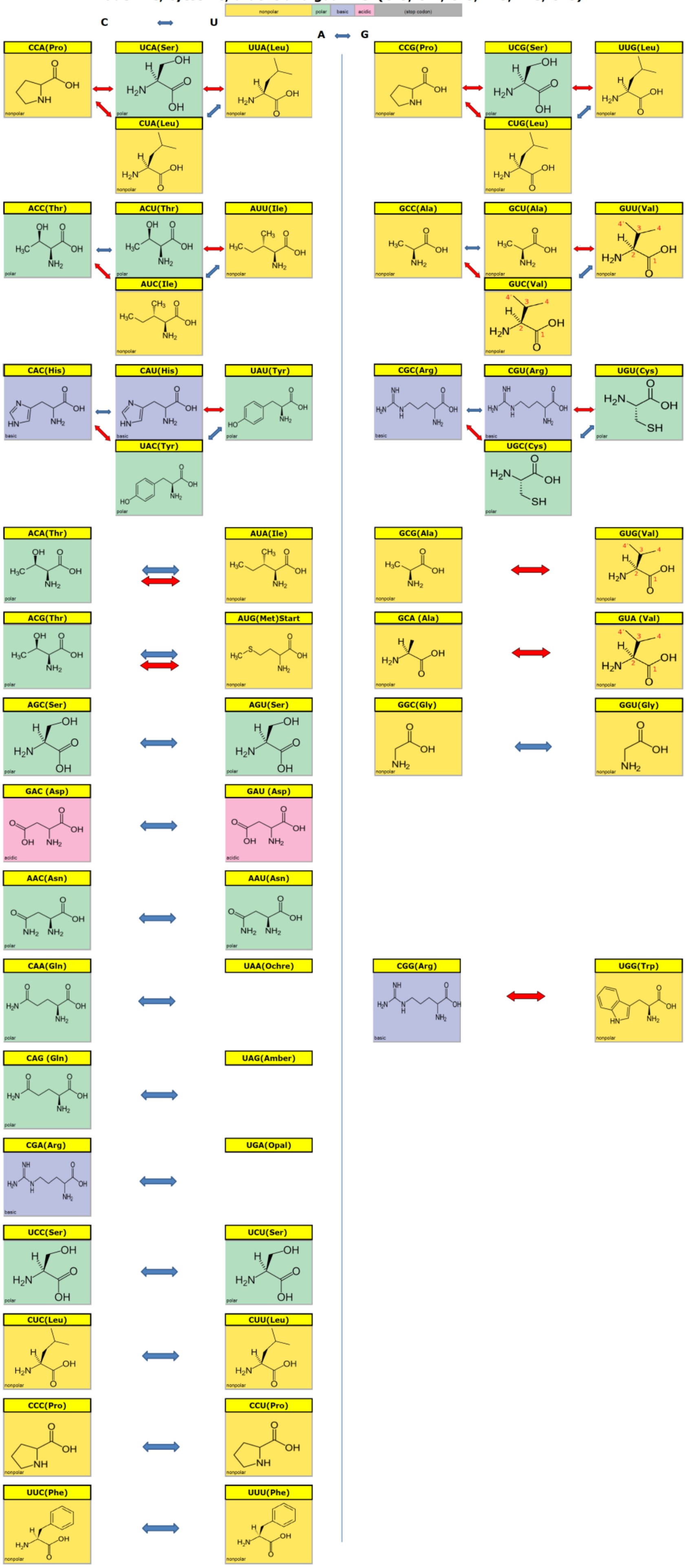
RNA codon homologous transitions

adenine, cytosine, uracile and guanine (C-U, C-A, C-G; A-U, A-G; U-G)



But the most important property of objects of material nature is not so much symmetry how many forms, methods and causes of disturbances in the real world.

This system of equations is formally very similar to the system of equations for halogen methanes (see. Tab. 2). In fact, these equations are the conservation law for the codons. But this is a topic for another article.

4.4 Unitary Symmetry and database NIST

Using the concepts of unitary symmetry enables fundamentally change construction of databases values of physical and chemical parameters of atoms and molecules. Concepts such as self-consistency and reliability of the parameter values within the closed class of objects composed of a single set of elements is the main feature of the new databases.

Currently, physical and chemical data in NIST represented as a set of experimental data or estimated for each object individually. Also presents the works of other authors.

In fact, all atomic and molecular objects are elements of a set of homologous series.

The essence of the future database is as follows:

1. Each molecule is known to consist of at least two atoms.
2. Each atom is part of a group of atoms with an equally filled electron shell (shells), involved in the formation of chemical bonds. (Homologous atoms).
3. Consistently replacing one atom at its homologous one, we get either a homologous series of molecules:

$$CO - CS - CSe - CTe - CPo$$

or a set of homologous series, as in the case of halogen methanes (см. Fig. 7).

4. All of the experimental and calculated data scattered molecules must be located in a folder under the code name "homology with elements (for example) 5 period. This folder, in turn, will have subsections related to the permanent element (e.g., carbon) or a group of elements (e.g., benzene ring).
5. Advance may be made of the system of equations similar to the equation shown in Table 2.
6. Substitution into the these equations the experimental data and their variation within the experimental error will provide a self-consistent set of parameters and produce estimates have not yet measured values.
7. An exemplary embodiment of the database should look like as shown in Fig. 19

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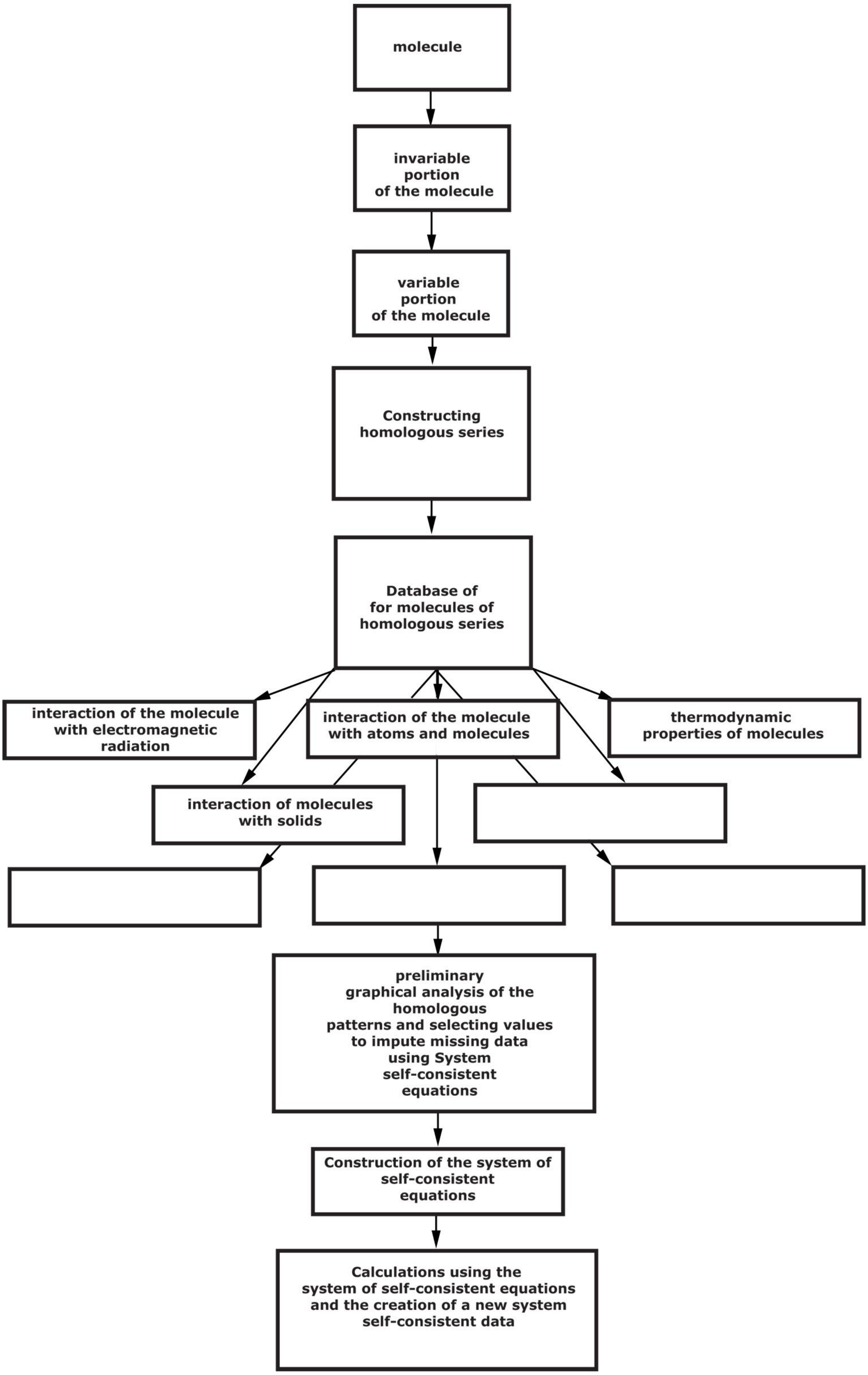

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Fig.19. Block diagram of the construction of a database of physical and chemical properties of molecules. Empty cells are reserved for a variety of physical and chemical parameters of stable nuclei and their isotopes, atoms, atomic ions, molecules and radicals.

5. Educational means of the XXI century

The main goal of modern educational facilities have to teach a child to perceive the surrounding objects not only in their isolated form, but in an evolutionary format.

Main principle of the Spiral Educational Approach is to provide children of all 15 core subjects for the study of early childhood.

5.1. Baby cot - classroom number 1

If you want your child to develop active and versatile, connect the child to the educational process not only through the subjects perceived him through conditional reflex action - played with dice, praised, but also objects of a higher educational level, which until some time the child will be perceived "moving eyes "as the sky, as air ... Based on the course of unconditional reflex activity. Start with "Learning cot", "Teaching floor", "Learning Wall" ...:

The most common objects and images used as educational tools are drawn (separately) animals . There is information about the appearance . No traces of generalization and building laws - educational potential is almost zero .

And this is the wrong way!

Much more useful to present some initial classification of the animals. On the walls of the bed can be placed illustration of one of the basic laws of nature (as an introduction to statistics) - a normal distribution . On parts of the crib can be placed visible portion of the electromagnetic spectrum , geometric shapes , etc. (see Fig.20)

Fig.20. Educational Baby cot allows you to submit your child for the first unconditional perception patterns. This incredible poster presents a tremendous amount of information in an easily understandable way. Along the left edge, the major milestones (physical developments) of vertebrate evolution are shown and described.

The milestones are marked on it to show the resulting animal clades. The beginning and end of each branch shows when they lived; the thickness of the branch indicates their relative abundance or scarcity during each geological period. 119 species are shown, all in the proper geological period. This makes it easy to see which animals lived at the same time. Interesting insets explain everything. [15]

5.2. Playground - classroom "Open air"

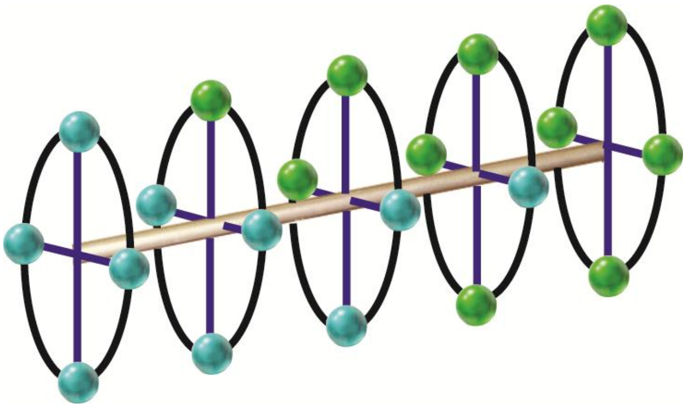
What are their playgrounds yourself ? Set of swings, roundabouts , slides , etc. There are also more advanced tools [16]. **But all these structures only develop motor skills of children.** Playground - a real educational polygon. Educational potential of the vast majority of playgrounds stood at zoo inhabitants.

I greatly improved these structures. They appeared scientific basis.

5.2.1. Easy "Climbing homology"

I will focus here on only one direction - the creation of training playgrounds. As I have proposed the concept of Education Playgrounds a major role played by the representation of Combinatorics and Homology.

Here is the simplest representation of Homology for Playground (Fig. 21)



WWWW - WWWY - WWYY - WYYY - YYYY

Fig.21. This design represents the image of the homologous series. There is one object (or quantification of a certain quality) step by step is replaced by another (akin to the shape but different content) object (or quantification of a certain quality). Here W - white ball, Y - yellow ball. (combinations of 2 to 4 - homologous series).

We have developed a Playground Equipment similar to those shown in Figures 5, 6,7,8,9,10,11.
A few examples of the conversion of conventional playgrounds in Educational Playgrounds are shown in Fig 22.

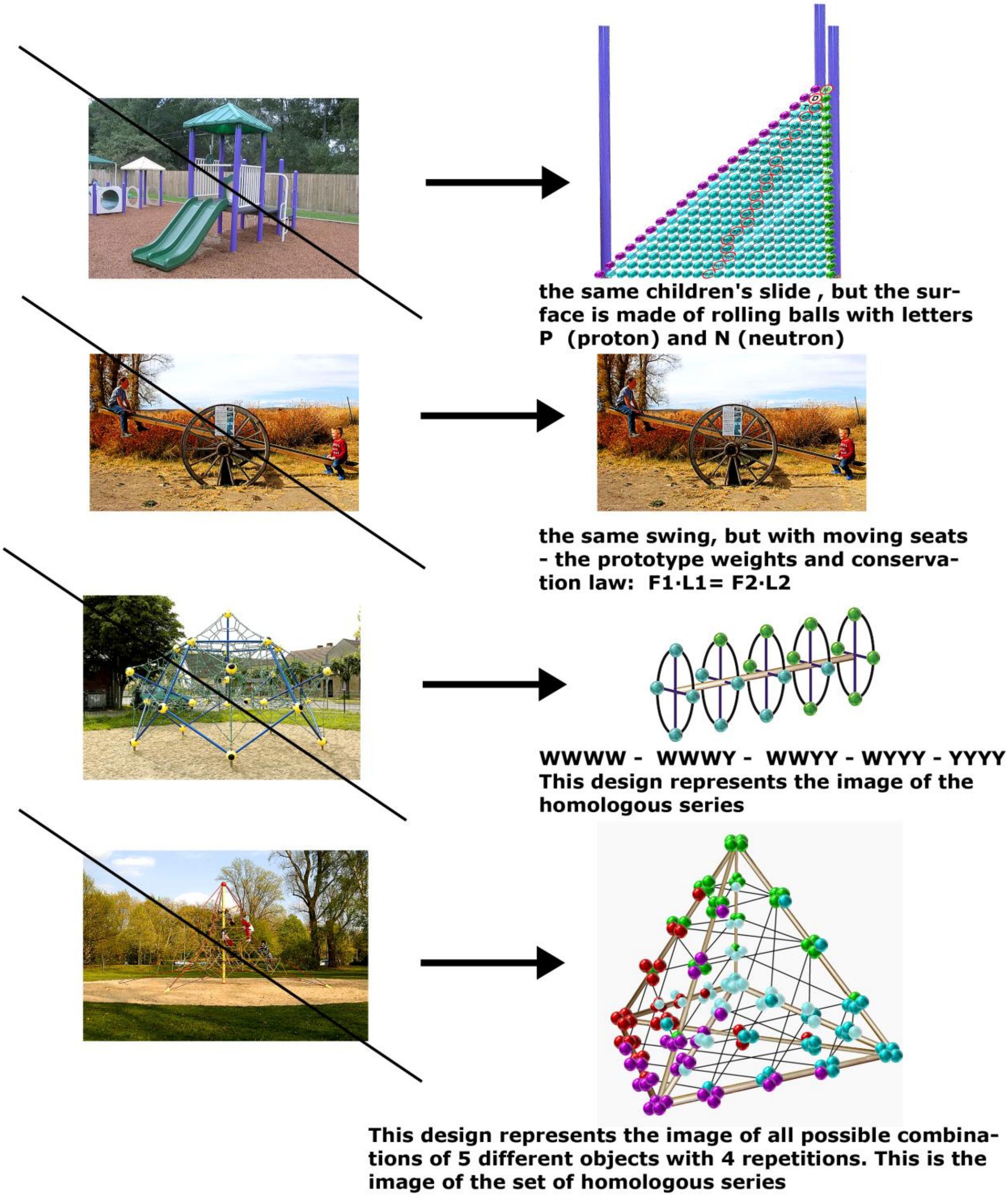


Fig.22. These are the design will develop children not only physically, but also are excellent teaching tools at the level of unconditioned reflexes.

These " Intelligent playgrounds Equipment" that give children not only interesting, physically developed their design , but also the fundamental scientific knowledge , unconscious during the " pre- climbing ", but easily reproducible in different images when meeting with natural science in school and future career

It is a powerful educational foundation that can take the schools at the shiny new educational tools on an intellectual level - **Teaching PlayRope Playground Equipment.**

5.3. School walls

School walls of the corridors have a huge potential for learning. About a third of the total time the residence time children spend in school of walking, running, jumping ... .

Placed on these walls posters lay the first information layer at the unconditioned reflex. The child will be much easier to understand the new teaching material in his study on the targeted lesson.

What should be placed on the walls? (See Fig. 23, Fig. 22, Fig. 25, Fig. 26).

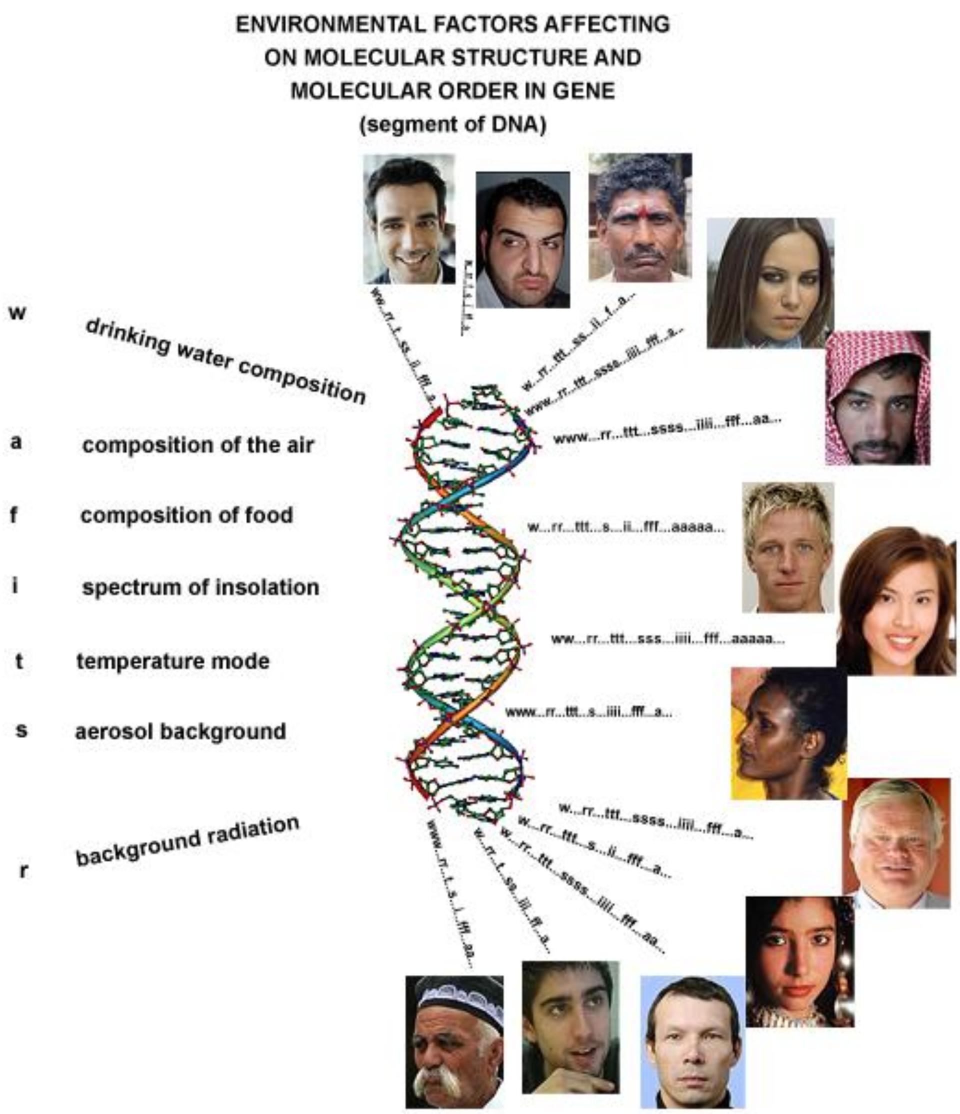


Fig. 23.Formation and development of all life on earth is defined by seven natural factors: 1. composition of drinking water (w), 2. composition of the air (a), 3. food composition (f), 4. range of insolation (i), 5. temperature regime (t), 6. aerosol background (s), 7. background radiation (r). Seven factors (w, a, f, i, t, s, r) according to their percentage composition in natural combinations led to the formation of all ethnic branches of

Homo Sapiens. And to this must be drawn into children from an early age. This is the path to racial tolerance.

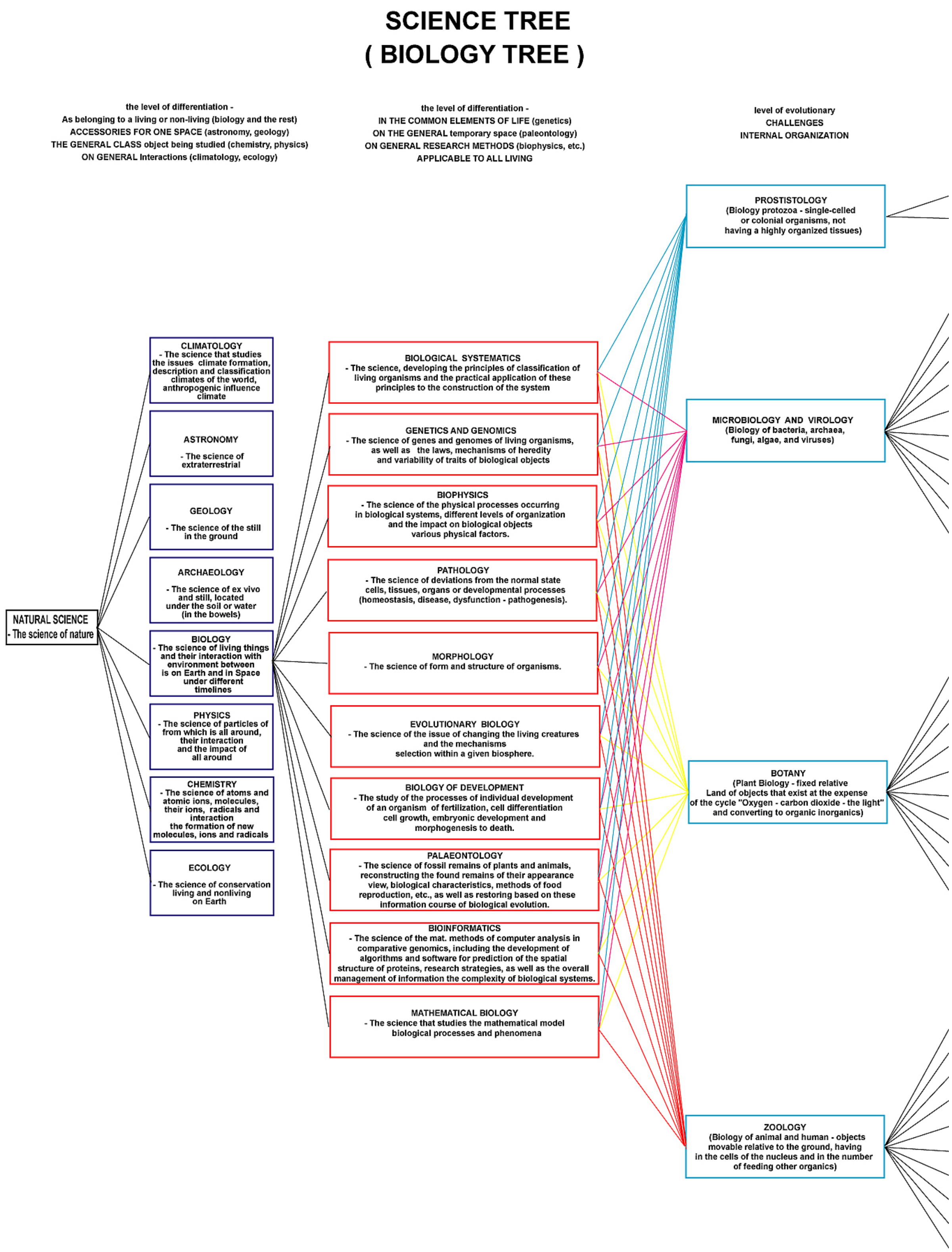


Fig.24. Biology Tree

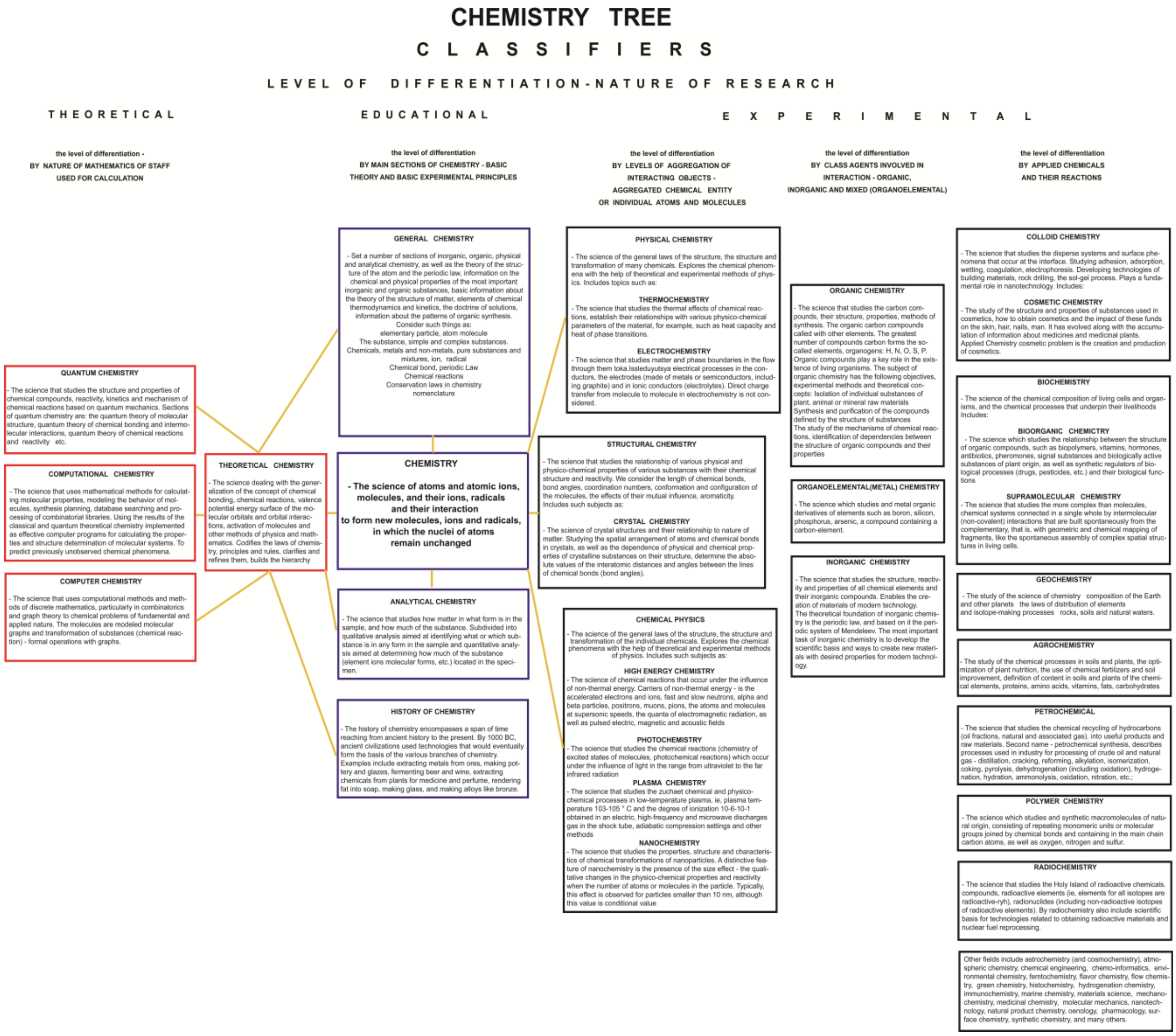


Fig.25. Chemistry Tree

Below is an location example of such posters (Fig.26).

Fig.26. Examples of arrangements of posters on the walls of the school corridors

What is the usefulness of such posters?

Conscious step in a child's education will make it easier.

6. Summary

- proposed Spiral system of teaching children from 3 to 17 years.
- developed and proposed a new form of combinatorial operations associated with the concepts of Homology and Symmetries.
- proposed a new definition of Homology and shows its difference from Analogies.
- proposed a combinatorial representation of chemical elements and their isotopes and ions.
- proposed the possibility of constructing Self-consistent databases (SCD) on the basis of representations of the Unitary Symmetry of atoms and molecules.
- proposed layouts " Educational children's room", "playground Education" and "Educational school corridors".
- proposed a fragment of Science Tree, for example, Biology Tree and Chemistry Tree.

This knowledge will help students and teachers achieve three major objectives: **to familiarize students with a growing amount of information for a very limited time of the learning process , to teach children analytical thinking, to create tools and techniques to address the first two problems.**

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