



DEVELOPMENT OF UNIVERSITY STUDENTS' ABILITY TO UNDERSTAND THE WORLD SCIENTIFIC PATTERN

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Abstract: The natural and scientific pattern of the world is seen as the highest form of integration of modern physical, biological, chemical and geographical knowledge, which synergistically reflect the existence of the four fundamental interactions – gravitational, electromagnetic, strong and weak. The article reveals the geochronology of the planet development after the Big Explosion in five successive evolutions: 1) the evolution of elementary particles, 2) the evolution of the chemical elements, 3) the evolution of minerals, 4) biological evolution under the idea of eternal life, 5) social evolution (the appearance of human). Disclosed features of scientific kernel of biology, which is the principle of "DNA mitosis", are provided.

Keywords: words scientific pattern, world natural pattern, education, knowledge, planet development.

Introduction

The study is based on the following conceptual assumptions: 1) science and education are the specific activity for the production of an objectively true and systematic knowledge, 2) scientific knowledge is consistent with the principles of rationality, verification and falsification, 3) the content of education is the teaching category that is a model of social order at the methodological level and embodied in the disciplines of the curriculum, 4) the scientific world exists as a model. The model of natural and scientific world pattern (MNSWP) is referred as the highest form of integration of modern physical, biological, chemical and geographical knowledge, which synergistically reflects the existence of the four fundamental interactions – gravitational, electromagnetic, strong and weak.

Nature cannot be divided into subject and object, human and inhuman, biology, physics, chemistry, geography, geology, astronomy. However, the development of students' ability to understand scientific pattern of the world is the subjective comprehension of the objective reality, passing through the prism of social experience of humanity. This creates a methodological contradiction between object and subject, between the infinite nature and limitations of the part investigated by humanity.

Teachers are looking for approaches to the development of a coherent MNSWP based on the generalization and systematization of consistent fundamental laws, theories, concepts and principles in partial scientific world view and integration of the latest into the MNSWP. They also do this by means of the parallel systematization of knowledge based on the general laws of nature during the consideration of each topic of a course. Paradigms of modern pedagogy suggest that all effective teaching systems and educational tools are useful to exist. The main remark concerns the methodology. We believe that it is incorrect way to split the integral MNSWP into the physical, chemical and biological one. We believe that the general scientific world pattern comprises all the colors of natural knowledge.

Results

The integrity of the MNSWP is the result of emergent reflection of relations between its elements at all levels of the matter organization. This approach to the development of the MNSWP is necessary in order a teacher can ask himself or herself and then ask the students: "What was when there was nothing?", "How and where did something develop?", "Can a person destroy lives on the Earth?", "Why is photosynthesis called the transition energy of the light into energy of chemical bonds?", "What are the possible solutions to the ecological crisis?" and others.

The MNSWP demonstrates the highest level of the integration of physical, biological, chemical and geographical knowledge, which synergistically reflect the existence of the four fundamental interactions – gravitational, electromagnetic, strong and weak. These interactions serve as the drivers of changes in the

world: geophysical processes of evolution and functioning of the local landscape and aquatoriums, chemical properties of atoms (electronegativity, valence, the degree of ionization) and reactions of life in cells (DNA replication, protein synthesis, photosynthesis, chemosynthesis, and respiration).

To understand the holistic MNSWP, it is important to know about the existence of the four fundamental interactions and use the systematic thinking, which allows all the relationships in nature to be explained.

The gravitational interaction defines universal gravitation providing the phenomenon of life on the planet by the Earth's rotation around its axis and around the Sun, as well as the rotation of the Moon around the Earth. Gravity is a physical reflection of the properties of matter – that is, mass. Any particles (air, water, living organisms, etc.) are kept at the surface of the planet due to the gravity.

The electromagnetic interaction (there are two types of charges: positive and negative) is also important property of matter. The same charges repel each other, but different are attracted. All chemical and biological processes on the planet are the direct or indirect manifestations of electromagnetic interactions. Electric charge forces a substance to be responsible for the formation of atoms and molecules and for their properties.

Strong interaction is the internal nuclear forces that are responsible for the communication of protons and neutrons in the nucleus of the atom. The peculiarity of these forces is that they yield considerable energy that holds together similarly charged particles of protons in the nucleus.

Weak interaction is responsible for the transformation of elementary particles in the microcosm with the release of neutrinos. These reactions are manifested in the glow of the sun and are its main source of energy. The energy of the Sun serves as the driving force of nutrient circulation of atoms and transforms the living matter of autotrophic organisms in the energy of chemical bonds.

Due to the four interactions, our planet receives from the sun almost $10.5 \cdot 10^6$ kJ/m² per year. About 30% of this energy is returned back into space, 69% is absorbed by the atmosphere, soil, hydrosphere and expended on evaporation and precipitation. The rest of energy (about 1%) is spent on photosynthesis, and is the primary source of life on the Earth. This transformed solar energy allows living matter to carry out geochemical work on the planet in the form of movement, respiration, reproduction, nutrition, excretion, growth, development, death and decay. The combined biogeochemical activity of living matter led to changes in the composition of the Earth's atmosphere. It has become a type of restorative and oxidative atmosphere with modern oxygen. The energy of the sun in the trophic chain is able to penetrate deeply into the middle of the biosphere.

Space photosynthesis starts the formation of CO₂ and H₂O, as well as various complex biomolecules (carbohydrates, proteins, nucleic acids, etc.). This not only increases but also complicates the original information (chemical) before the emergence of a qualitatively new kind of information - genetic (biological). Under the influence of external conditions (e.g. ionizing radiation, certain chemicals), this information can be mutated. Due to reproduction, this information is duplicated and transferred to future generations. Finally, the information can be hidden in the geological strata in fossil flora, fauna, fossil fuels etc.

Biological phenomena are specific. Objectively, the true proof (or disproof) of the occurrence of life in the form of the principle "DNA mitosis" is not able to affect the reality of its existence. We believe that it is the principle of "scientific and research biological core" because it corresponds to the basic signs of life – self-reproduction and self-organization. Theoretical and methodological "protective belt" for the kernel of biological sciences is the fundamental theories and concepts: cell theory, the taxonomy of living organisms, synthetic theory of evolution, the hierarchy of life on the planet, types of power (autotrophic and heterotrophic). The content and interpretation of these theories of "protective belt" are continuously refined, updated, debated, but it protects the core (the principle of "DNA mitosis") from the rebuttal. When the methodology of protection is considered unsustainable, then it will be necessary to change the kernel.

The idealized design of the "DNA mitosis" is a specific theoretical concept. The process of learning biology by students in high school is advisable to be directed to the development and enrichment of the concept by means of moving from the abstract to the concrete. It is recommended to organize biological knowledge about the "research kernel of biology by means of integration of teaching materials (knowledge of fundamental theories and specific concepts).

To build a foundation model of a scientific world view, we adhere the following ideas: 1) the material universe has always existed and will always exist, 2) there are three forms of matter existence - substance, field and vacuum, 3) the birth of matter, time and space of our planet are the result of the big explosion of infinitely small radius, extra-large density and temperature, 4) after the big explosion, the world developed

according to the five successive evolution steps – processes of material bodies complications (Table 1): 1) evolution of the particle, 2) evolution of chemical elements, 3) evolution of minerals, 4) biological evolution, 5) social evolution.

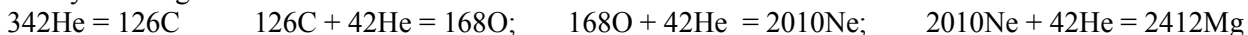
When discussing "What was before the big explosion?", scientists are turning to concepts of "primary vacuum", the nature of which is investigated. Before the big explosion, physical rules were not performed and there was no time. We used to measure time by the uniform motion of matter - the rotation of the Earth around the sun (a year) around its axis (day / night), the half-life of atoms course, the clock and so on. If the motion of matter in space is taken as the time, then formally: "No events - no time". The existence of so-called "Arrow of time" is a consequence of the second law of thermodynamics - unauthorized forward motion of matter by the gradient (from the point where the concentration is the most to the point where concentration is the least, from hot to cold, but not vice versa). So, there is a reason to believe that the directed movement of matter is a category of time and reflection of its irreversibility.

Consider geochronological stages in the evolution of the Earth.

Evolution of particle starts with the big explosion 15-10 billion years ago by means of accelerated expansion (within 10-43 s) of the over saturated (1080 g/cm³) and overheated (1027 K) point of the universe sized of 10-33 cm. The explosion created elementary particles of almost 300 types (quarks, photons, neutrinos, electrons, positrons, protons, neutrons, etc.). The whole visible universe was formed by means of a single act accompanied by cooling of matter and radiation. Such a distribution is indicated by the displacement of spectral lines of distant galaxies in the red part of the spectrum (the so-called "red shift") - galaxies are moving away from the Earth.

The evolution of the chemical elements is observed after lowering the temperature when protons and neutrons started to form nuclei of heavy isotopes of H and He. Thermonuclear reaction of chemical elements from the elementary parts (protons) occurs with the ultra-high temperatures and pressures, which provide collision of similarly (positively) charged particles repelling each other. This "hydrogen burning" is constantly happening on the Sun and the biosphere provides energy to maintain homeostasis of life.

The Sun was formed about 5 billion years ago, the birth of the Earth is within 4.6 billion years. The study of the chemical composition of the sun due to the methods of spectral analysis revealed that almost 75% of mass of H holds about 24 % of He. The rest 1-2 % is other elements. The process of converting helium into heavier nuclei occurred in the bowels of the earth under conditions of ultra-high temperature (within 1080C) and density of 103 g/cm³:



Thus, the starting material for the construction of all elements was hydrogen.

Then, naturally continuing evolution of minerals - the formation and transformation of oxides, salts, and a variety of materials (including organic) of inanimate world was the subject of study of the geochemistry and geology. According to the Le Chatelier's principal, hot planet had been able to synthesize oxygen long before photosynthesis scheme: $2\text{H}_2 + 2\text{CO}_2 = 2\text{CH}_2\text{O} + \text{O}_2\uparrow$

Biological evolution. We adhere to the scientific view that life did not arise from nonliving matter, but appeared in the form of anaerobic heterotrophs and chemosynthetic substances in favorable conditions for this purpose on the Earth in the archaea. There was no free oxygen in the atmosphere of the archaea (however, there might have been too limited content of it). This ecosystem has been able to create a primary biogeochemical cycles through food chains, such as "inorganic compounds → hemotrof of the first order → hemotrof of the second order → decomposing hemotrof."

The idea of eternal life is a scientific one, since there exist fundamental provisions of biology - living comes from living (Francesco Redi), which contains a provision of the cell theory - cell derived from the cells (Rudolf Virchow). This approach confirms the matrix principle of "DNA - mitosis", which is universal and difficult to refute.

The emergence of the living from the dead (by A. Oparin – D. Haldane) requires a critical review, as there are arguments against the hypothesis of abiogenesis:

1) Abiogenesis hypothesis does not explain the mechanism of occurrence of information matrix - the genetic code of DNA (or RNA) from the standpoint of self-organization of matter. It should be taken only as belief. Gen of future generation is based solely on the matrix gene of the previous generation.

Table 1

Geochronology of the Evolution on the Earth

<p>Era of new life KAYNAZOY 67 m years ago – present time</p>	<p>The global environmental crisis. Techno sphere. The development of science and culture. Development of crafts, towns and cities. Continuous development of neural groups of the brain for storing and processing information. Human settlement on the planet. Gathering, hunting, fishing, farming, animal husbandry. 200-150 thousand years ago - a revolutionary emergence of modern Homo sapiens - Cro-Magnon man. The social evolution of Homo sapiens (Homo sapiens L.) 700-50 thousand years ago - there was a Neanderthal man in the world (along with Cro-Magnons). Neanderthal man is a dead end of Homo genus. 1.5 million years ago - a population explosion of the genus of Homo as archanthropinae - ancient people: Pithecanthropus, Sinanthropus, Heidelberg man, and others. Dominance of angiosperm plants, birds, mammals.</p>
<p>Era of middle life MEZOZOY 230 – 67 m years</p>	<p>100 million years ago - the final formation of the biosphere as a unified system of substance, energy and information exchange The first flowering plants 200 million years - a population explosion of terrestrial warm-blooded animals on land</p>
<p>Era of ancient life PALEOZOY 570 – 230 m years</p>	<p>Distribution of reptiles 300 million years ago The first terrestrial vascular plants, terrestrial amphibians 400 million years ago - the oxygen content corresponds to the level of a modern atmosphere 500 million years ago – plants were out of the water to the land The appearance of the first chordates.</p>
<p>ERA of early life PROTEROZOY 2,6 b – 570 m years</p>	<p>The ozone layer in the stratosphere begins to form Growing microorganisms, algae, invertebrates and non-cranial creatures. Start of forming soils on land. 1 billion years ago – creation of oxidizing atmosphere (low oxygen within 3-4%). The emergence of aerobic bacteria. The emergence of eukaryotic (nuclear) organisms</p>
<p>Era of primary life ARHAEA 3,6- 2,6 b years</p>	<p>2 billion years ago, photosynthetic prokaryotes gradually increase the amount of oxygen in the Earth's atmosphere; deposits of organic origin (limestone, graphite, etc.) are formed. Dominating celled prokaryotes in renewable atmosphere 3 billion - the first appearance of photosynthetic prokaryotes. Start of biodiversity in the biosphere Living matter becomes the creator and bearer of biogeochemical energy on the planet The appearance of the first anaerobic heterotrophic microorganisms Biological evolution originates 3,8-3,6 billion years ago</p>
<p>Starting point</p>	<p>4 billion years ago – occurring conditions for the emergence of life on the Earth Evolution of Minerals Formation of the Earth about 4.6 billion years ago Evolution of chemical elements: the thermonuclear fusion of all the elements from hydrogen and helium. The formation of the sun about 5 billion years ago. The formation of the solar system from the protoplanetary nebula substance that was rotating and skewing Evolution of particles 15-10 billion – big explosion</p>

2) Hypothesis by O. Oparin - D. Haldane leaves open the question of transition of coacervate droplets to these living cells. Assuming that "probioticity" arose from nonliving coacervate droplets, we may put a question of how it will survive in the future. Could natural selection have acted in the event of the appearance of living from dead in "nutrient soup" where there was life in the form of the existing ecosystem food chains and the struggle for existence? Prokaryotes with the reasons for the rapid propagation over a short geological time would run out of nutrients in this soup.

3) Living matter by Louis Pasteur must consist only of pure chiral structures (isomers of only one class: "+" or "-"). All proteins in nature are built exclusively with left-rotating (-) L- amino acids. DNA consists of only right-rotating (+) D-ribose. Substances of non-biogenesis are of chiral symmetrical - the "left" and the "right" molecules equally. Chiral purity is a necessary condition for the existence of the principle of "DNA mitosis" as a replication of nucleic acids by the nature of living things. It indicates the impossibility of obtaining a living from the nonliving, the existence of qualitative boundaries between living and nonliving (Rudyshyn, 2013). Therefore, it is correct to speak not about the origin of life on the Earth, and the creation of conditions in the world for the emergence of life on it that was almost four billion years ago. Living matter was in the form of anaerobic heterotrophic prokaryotes – chemosynthesis that over one billion years of organic matter were synthesized by the energy of chemical reactions (chemosynthesis in oxygen are released). About three billion years ago photosynthetic organisms appear first allowing living matter more actively to fulfill the mission of being creator and bearer of biogeochemical energy of the sun. For almost two billion years of archaia, living matter through photosynthesis gradually increases the concentration of oxygen in the atmosphere (in the Proterozoic it was already 3.4%). The atmosphere becomes oxidizing, which is an example of an environmental disaster.

Autotrophic evolution deepened with the emergence of multicellular organisms that provide better stability of ecosystems. It starts growing aerobic microorganisms, algae, invertebrates and non-cranial creatures, accumulating bottom sediments in the seas and oceans. There is an ozone screen, which protects all life from harmful ultraviolet radiation and allows living organisms on land (about 500 million years ago).

Oceans - the oldest natural system in which the process of constant exchange and transformation of energy, matter and information in the world takes place. The uniqueness of the ocean is a synergistic manifestation of unification of various physical, chemical and biological processes in a single ecosystem. During the evolution of the Earth's oceans, the nature repeatedly has been changing under the influence of different processes: solar radiation, geological and geochemical factors and, most importantly, under the influence of geochemical work of living matter.

Without an idea about the evolution of biosphere from a geological point of view, it is impossible to imagine the impact of living organisms in the lithosphere, the formation of geological deposits. V. Vernadsky wrote that granite is the past biosphere, as research of carbon dissemination in primary sedimentary rocks showed its biogenic nature. Thus, the evolutionary process of living matter continuously covers the biosphere throughout the geochronology of the Earth and appears in the lifeless bodies. Herewith, the more organisms affect the environment of the biosphere, the more intensively they evolve (Vernadskiy, 2004). Given this phenomenon, we can say about changing and evolving biosphere as a whole, not just its individual parts. The evolution of species precedes the evolution of the biosphere.

400 million years ago in the Paleozoy, the oxygen content was consistent with its level in a modern atmosphere. Growing terrestrial vascular plants and amphibians were observed. Living organisms with inert substance gradually formed inert substance of soil. The final formation of the modern parameters of the biosphere, as a single system, was 100 million years ago. Angiosperms, birds and mammals started their domination.

Social evolution is related to the appearance of a human (anthropogenesis) on the Earth. The evolution of a human is unusual and does not fit the biological limits outlined by the Darwin's theory. Unlike the animals a human: 1) does not adapt to nature and is separated from it. Tools, a variety of weapons, fire, and clothing, synthesis of new substances that do not exist in nature, mining and others are the methods by which a human is singled out from the environment, creates its own artificial world. 2) A human kills another human. This denies the evolutionary law of biological survival of the species - the destruction of intraspecific is inappropriate in nature because it is a self-destruction. 3) Among all creatures living on the Earth, only a human leaves chemical and physical "garbage" that pollutes the environment (in nature it is absorbed and

transformed into food chains), destroys its own habitat, its own ecological niche. Thus, it remains an open question: if a man is a part of the nature, why does he destroy the whole?

Social evolution continues as a global environmental crisis and the creation of the techno sphere. The human impact on the biosphere leads to irreversible processes of reduced biomass, the changing nature of the accumulation of solar energy in the surface membranes of the planet, reduced biological and landscape diversity and others. However, environmental problems are the problems of man, not nature. This is a separate issue concerning development of a model of co-evolutionary existence of "society - biosphere" when humanity learns how to meet their social and economic whims within the buffer capacity of the biosphere (Rudyshyn, 2014).

Discussion

The model is a conventional image of the real world view. The perception of the world through the model is always subjective (only subjects, not objects think). We believe in the selection of theories (hypotheses) to construct a model based on scientific critiques (use of competing models). Theories having the greatest resistance to criticism and offering the most convincing evidence of the truth, in comparison with other available theories, can be defined as the "science" of a particular era. The development of science is in changing one model by another, which is more practical. For example, the Ptolemy's model of the universe was replaced by the Copernic's model; a model of a gene in a protein matrix was replaced by the DNA matrix. Science is the product of voluntary consent and open debate of scientists about the true content of systematic knowledge. The outlook is largely dependent on the point of view of scientists - that's a paradox.

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