Peculiarities of teaching biology as part of curriculum of discipline "The Basics of Natural Sciences"

Rusudan Vadatchkoria

Peculiarities of teaching biology as part of curriculum of discipline "The Basics of Natural Sciences". *The article justifies a necessity of introduction of the students into the professional course "Pedagogics" to variety of the most important aspects, phenomena and regularities of Nature from the point of view of biology and physics. A need for integral approach to the natural sciences teaching and close relationship of disciplines such as biology, physics, astronomy, chemistry, geography and mathematics is demonstrated. Detailed curriculum is developed and theoretical material of the biological part of the latter in electronic version is prepared. Special attention is given to the current ecological problems, pollution and protection of the environment. For each separate topic, a system of tests to control and estimate the quality of the mastered material is prepared and represented.*

Key words: *Biology, Physics, Live, Organism, Energy, Substance, Theory, Ecology, Environment, Pollution.*

INTRODUCTION

The problem of training highly skilled teaching personnel for elementary school has become acute in the recent years. This is especially important, as in elementary schools, considering age peculiarities and increased ability of the students to perceive the material, a background for further education is laid, the horizon and an overall perception of the surrounding world are formed. Considering this, the professional standard of elementary schools teachers is to correspond to the requirements of time, to scientific and technical progress and to the constantly developing intellectual potential of the growing up generation. Consequently, training programs themselves, both for students of higher educational institutions and for those of elementary and secondary schools, should be constantly revised, updated and improved.

This educational Program "The Basis of Natural Sciences" intends the logical knowledge transfer from the lecturer/ instructor of the higher educational institution/ university to students, prospective elementary school teachers/ instructors, and further on, from the latter to schoolchildren, learning the subjects "Human and Nature" and "Everyday Life and Technology".

The Program proposes a few training topics, which are basically considered from the point of view of physics and biology, but apart from that, includes introduction into astronomy, geography, chemistry, philosophy, history and mathematics, thus demonstrating close correlation of these disciplines and the importance of such correlation in the process of learning and formation of comprehensive knowledge, as well as holistic approach to the understanding of the surrounding World and the nature.

The Program cannot be isolated from the knowledge of elements of pedagogics, psychology and methodology of teaching, either; it does not intend merely the transfer of the knowledge about laws and phenomena of nature and still life; the main goal is to activate associative logical thinking of students, to develop their abilities for reasoning and analysis, to make correct grounded conclusions, to develop interest in understanding nature and to stimulate further educational process; additionally, it inoculates some skills, necessary for the acquisition of life experience and adaptation to the social-welfare conditions.

Some topics of the proposed Program are tightly connected to the observation of the most acute problems of ecology and protection of environment.

COMMON OBSERVATION OF THE CONTENT OF THE PROGRAM

The above mentioned tasks can be solved by introduction into the training process of the indicated Program, including the following topics. The introductory topic of the

whole course of “The Basis of Natural Sciences” is history and methodology of natural sciences. It proposes observation of some of the basic stages in the history of the development of natural sciences and sequential shaping of the natural-scientific picture of the Universe. Apart from several natural-scientific theories of a different direction, presented in the order of their development, a historical survey of the methodology of natural sciences is also conducted. In this respect, a logical need for a more detailed explanation of such issues as “Nature and Still Life”, “The Basic Criteria of Life”, “The Integrity of a Living Organism” from the point of view of biology, has arisen; an issue “The Category of Life and Death” from the point of view of philosophy, biology and medicine is also suggested. One will have to go back to these issues during the course, as all the subsequent topics are connected to the former in one way or another.

One of the most extensive, complex and important issues is “A Natural-Scientific Picture of the Universe”, which includes basic questions on the evolution of life on the Earth, i.e. the evolution of organic life. The historical development of evolutionary ideas – scientific, non-scientific, religious, scientifically grounded, demonstrative and unsubstantiated, theoretical, and those being a result of one’s conclusion only – is considered. In this issue, all the known theories about the evolution of life and organic world on the Earth, the evolutionary theories (religious, cosmic, Charles Darwin's theory), the theory of human evolution, should be presented as information, without subjective preference for any of them, in order to stimulate students’ reflection on these issues, and to give them an opportunity to make a choice as to the scientific and ideological position.

The extensive teaching experience shows that in spite of its complexity, the issue always causes lively interest amongst students, generating discussions, thinking, retrieval of new information, which is especially important for the intellectual development and molding of the horizon of students. Moreover, from the view point of pedagogics and psychology, the basics of behavioral ethics during scientific discussions, skills to express oneself, to listen to the opponent and to respect the opinion of the latter, are formed at such classes. Consequently, these classes require not only good theoretical preparation of the teacher and schedule of the course, but also knowledge of the basics of pedagogcs, psychology and age characteristics of the students.

During the learning of the subjects, concerning nature and living organisms, it is impossible not to pay special attention the issue “A Living Cell and Cellular Structure of Organisms”. The cell as an elementary structural-functional unit of living organisms is the basis of all the living things (except for extra-cellular forms - viruses and phages). The chemical composition and structure of the plant and animal cell and the organoids is studied here. Prokaryotic and eucaryotic cells are compared. Gradual complication of structure and functions of cellular organoids, as well as the cell as a whole, in the course of evolution leads to the formation of more complex structures: cloths, organs, organ systems, and finally, to the appearance of multi-cellular organisms.

This issue is closely connected to many biological topics and is actually one of the key ones in biology curriculum in general. Besides, it is recommended to give a general idea about systematics of living organisms, to explain the concepts of taxonomy and nomenclature, accepted in contemporary classification systems of living organisms. Both theoretical material and practical training are recommended for the topic “Cell”.

A separate class is dedicated to the topic „Movement”. Movement is studied as a physical unit, namely, as mechanical movement and force. Furthermore, movement is one of the functions of a living organism and an adaptive ability of organisms to survive in water, air, on the ground and underground, in its entire variety, beginning with various forms of taxises of microorganisms, to evolutionarily advanced motion, such as swimming, flying, walking, running, jumping, etc.

Based on the example of the supporting-moving apparatus of animals and human, it is possible to visually explain the structure and the operating principle of physical levers (I,

П, Ш type). It is easy to connect the topic „Force" of the division of „Dynamics" to the biological topic „ Muscles" and discuss the issue of measurement of the muscular force. It should be noted that any work, including muscular, is energy-dependent process, and then smoothly proceed to the following issue.

In the topic „Energy" various forms of mechanical energy, energy of living organisms, the methods of energy syntheses, storing, retrieval and consumption, are explained. Special attention should be paid to various everyday energy sources, including alternative sources, such as solar, hydrogen and others, in connection with acute ecological problems, as well as issues of pollution and protection of environment.

The issue of energy of living organisms should be connected to those of the transfer of substances into and from the cell and the general exchange of substances of organisms. Several forms of cellular transfer could be proposed for observation: simple diffusion, osmosis, passive and active transfer of substances. General exchange of substances of the living organisms is composed of water-salt (i.e. mineral), carbohydrate, protein and fat metabolism. It suffices that these quite complex biological issues are presented briefly, to obtain a general idea about the mechanism of exchange of substances and energy in living organisms.

It is suggested that „Electricity and magnetism" is studied not only as physical units, but as phenomena in nature as well: magnetotaxis in microorganisms, electrical signals in plants, electricity in electrical slopes, catfishes and electrical blackheads, the luminous organisms. The topic deals with electrical phenomena in nature, in everyday life and in production; a general idea about bionics as a science is here presented.

The topic "Light and Color" deals with explanation of light in the life of living organisms (phenomenon of photoperiodity, photo-taxis, photosynthesis).

The vision organ, eye, is learnt as a basic receptor of light and color.

During of evolution and complication of anatomy and physiology of individual organs / organ systems, eye had undergone a whole series of changes and finally acquired a more complex structure in a human being. The evolutionary complication of the nervous system organs: spinal and head brain, and especially cerebral cortex, boosts the formation of such unique sensory construction as visual analyzer. The issue of physiological vision dysfunctions, preventive treatment of eye diseases, surgical correction and vision hygiene is mentioned here.

A historical evidence of the development of microscopy technology is made. Optical methods and optical instruments, used for the observation of nature are studied practically: the principal construction of the light microscope is examined; the simplest work with making preparations and their investigation under a microscope is carried out. Some photos, slides, e-material of other microscope types (electronic, digital), medical and other optical instruments, should be demonstrated.

Additionally, the topic "Sound" as physical value, and the structure and function of the hearing organ of animals and human being can be dealt with; locational technical installations and forms of external ear can be compared; it should be emphasized that not only development of technology contributes to further development of science and learning of nature and still life, but also the structure of some organs of animals and human being (eye, ear) leads scientists to a thought about the structure of a whole series of technical instruments of special sensitivity by analogy to the structure of these organs.

The topics "Water", "Air", "Soils" are quite multifaceted; they are taught with the elements of physics, chemistry, geography and biology. For these subjects the structure, chemical composition, physical and chemical properties of water, air and soil, as well as their variety and distribution on the Earth are explained.

The biological aspect of these topics demonstrates the biological variety of all three living environments: water, air, earth and underground; it shows distribution of the biomass

of the living substance directly in the medium of habitat and also there, where these media contract each other; it demonstrates the adaptive ability of living organisms during distribution in the niches of inhabiting, depending on the changing environmental conditions at its different levels. Plants, animals, microscopic fungi and microbes in their entire variety are revealed in the given topics precisely in connection to the living environment and to those conditions of the inhabiting, which are present in this medium.

For the topic “Soil”, as additional material, the topic “Fertilizers” is suggested; it gives an idea about the variety and classifications of fertilizers, their composition and properties, about the time and the standards of their application to the soil, positive and negative influence on the agricultural crops and finally, on human health.

Global ecological problems of our planet are formulated in each of the above mentioned topics: “Water”, “Air”, “Soils”; pollution sources are determined; methods of ecological monitoring and revision of water, air and soil quality, chemical and microbiological purity are described; some fundamental laws and protective measures are also mentioned. All these are intended to protect biosphere and environment, on the regional, country, as well as on Pan-European and worldwide scale; the issues of rational use of natural resources and of the implementation of waste-free industrial technologies are touched upon.

Here appears an opportunity of a very important educational aspect and it might make sense to discuss the straight or defined participation of each citizen (regardless of age and the kind of activity) in these events.

These topics prepare the ground for the understanding of such issues as “Rotation of Substances in Nature”. Rotation of water, nitrogen, carbon, phosphorus and sulfur is dealt with separately; the diagram of each cycle is represented; the mechanism and participation of living organisms in these cycles is explained

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CONCLUSION

Introduction in the process of the proposed training Program “The Basics of Natural Sciences” with the extended and enriched biological part will make it possible to prepare highly skilled pedagogical personnel for elementary schools for the courses “Human and Nature” and ““Everyday Life and Technology”.

This part of the program will basically help to prepare students for the further educational process, namely, subsequent study of botany, zoology, human anatomy and general biology basics with elements of ecology. The joint teaching of the basics of physics and biology contributes to the integral approach of the process of instruction, it clearly demonstrates the connection of the sciences and helps to master the training material not as separated facts from the field of physics and biology, but ensures the integral perception of the mysterious surrounding nature and forms a general idea about the planet Earth.

The final goal of the Program is not only to enlighten or transfer the knowledge, but also, to develop interest amongst students in the further improvement of knowledge, which considerably depends on the level of the theoretical and practical preparation of lecturers/instructors, their skills, knowledge and competence, and certainly, on their attitude toward their profession.

On the basis of this Program a course of lectures in electronic version is prepared for each topic. For each lecture, there are the plan-content of lecture, list of literature, list of terminology and extensive illustration material (photos, figures, diagrams and tables). Control tests are worked out for each topic; theses enable checking the level of mastering training material by students with the minimum time consumption of the instructor. An e-version has the key advantage, namely, it can be easily renewed and adapted to specific teaching conditions. The course of lectures on the basis of this biological part of the

Program as well as with physics part together is being prepared for translation and publication.

LITERATURE

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Contacts:

Dr. Rusudan Vadatchkoria, The Shota Rustavelli Batumi State University, Medical Department, Georgia, tel.: +995 99 262542 (Georgia), +359 884 497235 (Bulgaria); e - mail: rv58@mail.ru;

The paper is reviewed.