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THE ROLE OF INTERDISCIPLINARY TOPICS FOR IMPROVING THE EFFECTIVENESS OF THE PREPARATORY COURSES IN MEDICINE AND DENTISTRY AT THE MEDICAL UNIVERSITY, PLOVDIV

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This treatise deals with the positive effect for establishing solid interdisciplinary and intradisciplinary relationships produced by an interdisciplinary approach in teaching the Natural Sciences at the university level. Its educational benefits expose the ineffectiveness of the limited and discipline-oriented approach formerly used. The interdisciplinary approach demands the choice of scientifically relevant topics borrowed from a variety of theoretical and specialized subjects

This study focuses on the nature of the scientific text; it analyses some of the major difficulties in the way of composition and presents useful tips for developing a stronger and more comprehensive argument. The interdisciplinary approach in teaching the Natural Sciences on a pre-med level requires the study of a variety of scientific texts (modified to suit the student needs at the pre-med level) chosen as representative of all the disciplines included in the University core curriculum: Human Histology, Anatomy, and Physiology; General and Molecular Biology; Physics and Biophysics; Radiology and Roentgenology; Bioorganic Chemistry and Biochemistry.

As practitioners of the interdisciplinary approach, we have set ourselves the following course objectives:

1. The acquisition of knowledge that is both systematic and highly applicable.
2. A better understanding of the significance Biology, Chemistry, and Physics have for the study of Medicine and Dentistry.
3. Ability to use examples from various scientific fields in constructing a coherent argument.
4. Ability to think outside the box.
5. Ability to express oneself in a scientific way.

In order to illustrate the way the interdisciplinary approach works, we have limited ourselves to the discussion of three basic topics.

Needless to say, they do not cover the entire gamut of possible interdisciplinary relationships:

1. Heart Activity and Blood Circulation within the Cardio-Vascular System.
2. The structure of the Atom.
3. Cell Composition.

The above-mentioned topics are treated from a variety of perspectives, i.e., from the point of view of Biology, Chemistry, and Physics. They show the essential interconnection between the pre-med courses and the university-level theoretical and specialized courses offered at the Medical University, Plovdiv.

The first topic – Cardio-Vascular System – has received two treatments, each suited to the purposes of Biology and Physics, respectively. The heart is initially treated in a Biology class, where the emphasis falls upon its organization and activity, cardio-vascular activity, and blood circulation. The same topic later appears in a Physics class, where the laws of Physics, applicable to heart activity and blood circulation, are discussed.

The second topic – Structure of the Atom – is also treated within the context of two separate courses: first-semester Chemistry and second-semester Physics. This topic is probably the strongest advocate for the interdisciplinary

approach, since it is the best example for the unity of the Natural Sciences.

The third topic – Chemical Composition of the Cell – is treated in both Biology and Chemistry classes. This topic encompasses the composition of the water molecule, the properties of water, and the vital role water plays for all living organisms. It deals with the chemical elements (C, H, O, and N) composing organic matter within the cell. The basic categories of organic and inorganic compounds are also introduced.

These three topics are discussed in detail in Attachments I, II, and III, respectively.

We expect the formation of solid interdisciplinary logico-semantic relationships, which would allow the prospective doctors and dentists to gain understanding of any new theoretical and specialized discipline, and would enable them to achieve a new level of understanding of the material they have already been acquainted with. The significance we attribute to the interdisciplinary method of teaching is based on our assumption that "the key to our understanding lies in the links we draw between new and familiar information" (Potts 1977).

We have good reason to believe, based on everything we have said, that the presentation of scientific knowledge on a pre-med level need not be boring and trite, but it could instead be highly engaging and useful to the students.

Attachment I: *The Cardio-Vascular System*.

This topic is first introduced in a Biology seminar. The heart is compared to a pump, which pumps in blood from the veins and then pumps it out into the arteries. The cardiac muscle alternately contracts (the contraction is called *sistola*) and expands (*diastola*). The auricles and ventricles contract as well: first the two auricles and then the two ventricles. The contractions create pressure which causes the blood to move. A definition is given to the concept of cardiac cycle, and its phases are enumerated. The role of the valves for ensuring that blood moves only in one direction – from the auricles into the ventricles, and, finally, into the arteries - within the cardio-vascular system is accounted for. The change of the blood pressure in the initial phase of the cycle is explained. The pressure in the arteries is highest during *sistola* and lowest during *diastola*. The topic also includes a discussion of *hyper-* and *hypo-tonia* (high and low blood pressure), and the factors which affect blood pressure. All these concepts are essential for the understanding of *auscultation*, i.e., the most basic diagnostic method used in medicine. There are two tones audible during the cardiac cycle, easily detected with the help of a stethoscope. The presence of noise is considered symptomatic for an irregularity in the activity of the heart.

In a Physics seminar the emphasis shifts to calculating the amount of work accomplished by the left and right ventricle, and finding a mathematical _expression that captures this amount. An equation is worked out to calculate the numerical value for heart capacity. This work ensures the blood circulation within the cardio-vascular system. A mathematical formula is offered and the meaning of Reinolds's number is explained. The conditions for laminar and turbulent movement are presented. The appearance of noise, associated with turbulent movement, is explained. Its diagnostic value during *auscultaion* and the measuring of the level of blood pressure according to Riva-Rocci's method is discussed. The emphasis is placed upon the various kinds of movement in the blood vessels – turbulent in the porte(?), laminar in the arteries, veins, and the capillaries. The value for the velocity with which the blood moves is recorded, and a connection is drawn between this value and the section of a particular blood vessel. Thus Physics, Medical Physics, Biology, Physiology, and Anatomy are seen to intersect.

Attachment II: *Structure of the Atom*.

The structure of the atom is first introduced in a Chemistry seminar, using the theory of the planetary model. The atom consists of a nucleus and electrons which rotate around the nucleus. The concepts of proton, neutron, and electron are explained, and their symbolic representation is notated. A few other concepts are introduced, such as serial number (Z), mass number A), atomic mass (Ar), *isotope*, and *isobar*. The protons play a crucial role in defining the properties of chemical elements. The notion of chemical element is expanded to include more information than the one already acquired in the introductory Chemistry course. The organization of electrons in the atom is discussed, and a few new concepts are introduced: Pauli's rule, the rule for minimum energy, and Kund's law.

In a Physics seminar, the students review their knowledge about the structure of the atom acquired from Chemistry. The emphasis falls upon the dimensions, charge, and mass that protons, neutrons, and electrons possess. The number of protons is said to coincide with the serial number the chemical element is assigned in the periodic table. The number of electrons is said to define an element's chemical properties. Thus an interdisciplinary relationship is revealed to exist. Borr's (?) atomic model for the hydrogen atom and Borr's three postulates are presented to the students' attention. . The following concepts are introduced: photon, quantum, stationary orbit. A connection is drawn between atomic Physics and nuclear Physics.

Attachment III: *Cell Composition*.

There are more than a hundred known chemical elements, but only twenty seven of these participate in the formation of living organisms. Consequently, the emphasis falls on C, H, O, N, S, and P … in a Chemistry seminar. The elements can be divided into three distinct groups, based on their presence in tissues and organs: macroelements (C, H, O, N, S, P, Fe, Mg, Ca, Na, U, Cl) constitute up to .001% of the cell mass; microelements (Cu, Mo, Zn, Co, Mn, Si, B, Se, I) constitute up to .000001% of the cell mass; ultramicroelements (Hg, Ag, U, Ra) constitute less than .000001% of the cell mass. C is studied in greatest detail, since it participates in the formation of every organic compound. These chemical elements form two kinds of compounds: inorganic (water and mineral salts) and organic (carbohydrates, fats, proteins, and nucleine acids). During the process of photosynthesis, green plants

synthesize on their own simple organic compounds – monosaccharides, aminoacids, and fatty acids. Living organisms use these simple organic compounds as a source of energy or as basic structural units.

The knowledge acquired in Chemistry about chemical elements, organic and inorganic compounds, is elaborated upon in a Biology seminar. Nine sessions are devoted to this topic. The group of the microelements gets special treatment, since they constitute 99% of the mass of a living organism. The reason for this is explained. H and O are extremely important because they form water, which is 70% of the cell mass. The importance of water for the existence of life, due to its properties, is underlined. Water is one of the best solvents. The biological properties of water are explained on a molecular structural level. The structure of the hydrogen atom and its ability to participate in the formation of the basic groups of organic compounds within the cell is reviewed. The composition and organization of carbohydrates, fats, proteins, and nucleic acids is given particular attention. Their biological functions are discussed.

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