

# BIOLOGICAL OBJECTS REFLECTED IN THE VERBAL ASSOCIATIONS OF BULGARIAN TEENAGERS

**Yordanka Dimova, Margarita Panayotova**

Plovdiv University "Paisii Hilendarski", Plovdiv, Bulgaria  
E-mail: dimova@uni-plovdiv.bg; margopan@uni-plovdiv.bg

**Darina Uzova**

Secondary School "Ivan Seliminsky", Sliven, Bulgaria  
E-mail: dari\_uz@mail.bg

## Abstract

*The article aims to introduce the reader with the results from the second part of a survey on the concept of "Nature" in the minds of 13-year-old Bulgarian students. This time, we focus on the question: What biological objects and knowledge are reflected in the verbal associations of the students?*

*The method of study used is a chain associative experiment carried out following the S (stimulus) – R<sub>i</sub> (reactions) pattern. Each participant is required to write down the first 7 words that come to their mind when the word "nature" is pronounced. 1400 reactions are used to reconstruct the associative fields objectifying the conscious and unconscious layers of the cultural concept of 'nature' in the linguistic consciousness of the participants (100 students in the 6<sup>th</sup> and 100 students in the 7<sup>th</sup> grade). We analyze 988 words-reactions that have connection to the biological aspects of the concept of "Nature".*

*We have also described how the associative experiment became a stimulus for organizing a competition for best painting and essay on the subject of "Me and Nature" at a school in Sliven.*

**Key words:** *associative experiment, the concept of "Nature", knowledge in biology.*

## Introduction

Knowledge about nature and the perception to nature as something important and valuable are key components of the cultural concept of "Nature". One of the main factors influencing the content and structure of this concept in the individual linguistic consciousness of the child and adolescent is natural sciences education.

A previous paper of ours that was published in the journal *Problems of education in the 21<sup>st</sup> century* (Dimova, Angelova, Russev, 2009) introduces a research on the associative field of the word "nature" in the linguistic consciousness of 13-year-old Bulgarian students. The results show that in the conditions of an associative experiment the teenagers from the groups that took part in the survey get over the already set stimulus-reaction pattern for verbalizing the concept of "nature" and go beyond the boundary of object and events perception and description of the material world (Dimova, Angelova, Rusev, 2009).

The current paper describes the results from a survey that is related to the biological aspects of knowledge about nature. Again, we have chosen 13-year-old students for the associative experiment because at this age a neat system of biology terms is being formed in their linguistic consciousness through their education in the school subjects of “Man and Nature” (5<sup>th</sup> and 6<sup>th</sup> grade) and “Biology and Health Education” (7<sup>th</sup> grade). The results from the survey give enough reliable information about the linguistic development of the average language carrier, about the productivity of the non-arbitrary (that is, guided and structured through education) acquisition by the carrier of concepts related to the knowledge about nature.

### **Context of the Survey**

In Bulgarian schools, the purposeful development of the content and structure of the cultural concept of “Nature” in the minds of the students is defined to a great extent by the content of the school subjects from the cultural and educational sphere of “Natural Sciences and Ecology”. “Man and Nature” is the subject that is taught during the elementary educational degree (from the 3<sup>rd</sup> to the 6<sup>th</sup> grade). The content of the subject includes basic physical, chemical, biological and axiological knowledge about nature, about the unity and variety of natural objects and phenomena. This propaedeutic knowledge is a good cognitive basis for the introduction in the 7<sup>th</sup> grade of the school subjects of “Physics and Astronomy”, “Chemistry and Environmental Preservation”, and “Biology and Health Education”.

The biology modules in the school subject “Man and Nature” (5<sup>th</sup> and 6<sup>th</sup> grade) focus the students’ attention on basic vital processes of organisms (plants, animals, man). The school subject “Biology and Health Education” in the 7<sup>th</sup> grade focuses on the knowledge of grouping of organisms; on basic taxonomic categories of the five-kingdom taxonomic system; on the role of the unicellular and multi-cellular organisms in nature and their importance to man. The main goal of the syllabi is to set up natural sciences knowledge and skills for examining natural objects, and to create conditions for teaching students to have a respectful attitude towards nature and perceive it as something important and valuable. [Учебни програми/School Syllabi, 2003]

The survey of the goals and terms (concepts) in the syllabi for the “Man and Nature” (5<sup>th</sup> and 6<sup>th</sup> grade) and “Biology and Health Education” (7<sup>th</sup> grade) school subjects allows us to introduce in a summarized form the biological aspects of the content of the concept of “Nature” (Table 1). This figure is later used as a reference point for the coding, introduction and interpretation of the data from the associative experiment.

**Table 1. Biological aspects of the concept of "NATURE".**

NATURE					
ANIMATE NATURE			INANIMATE NATURE		
VITAL PROCESSES OF ORGANISMS	ORGANISMS' ORGANS AND SYSTEMS	TAXONOMIC GROUPS OF ORGANISMS	INFLUENCE OF MAN ON THE ENVIRONMENT	NATURAL ENVIRONMENT	
Feeding	Organs of plants Organs and systems of animals and human beings	Prokaryotes	Preservation	Terrestrial environment	Air
Breathing		Unicellular			Atmosphere
Excretion		Plants	Pollution		Soils
Response to Stimuli	Organs of plants	Fungi	Destruction	Marine environment	Lithosphere
Movement					Animals, including Man
Reproduction	Organs and systems of animals and human beings	Animals, including Man	Recovery	Marine environment	Hydrosphere
Growth					
Development					

**KEY:** 5<sup>th</sup> grade  6<sup>th</sup> grade  7<sup>th</sup> grade

### Methodology of Research

In the introduction we stick to the ideas of the Russian scientist Yuri Karaulov (Караулов, 1987; Караулов, 1989) about the linguistic person and to the ideas of the Moscow psycholinguistic School for the linguistic consciousness (Ufimceva, N.V., Tarasov, E. F., Cerkasova, G.A., et al.), for the verbal associations through which research can be made and through which conclusions can be drawn, which conclusions would be important for the theory and practice of teaching various school subjects (Костова, 1992; Мартинович, 1993). The methodology of conducting a survey by carrying out an associative experiment has been presented in greater detail in our previous paper published in the journal *Problems of education in the 21<sup>st</sup> century* (Dimova, Angelova, Russev, 2009).

The *object* of the present survey is the linguistic consciousness of Bulgarian teenagers: 13-year-old Bulgarian students from four Bulgarian schools (in Plovdiv and Sliven). The *subject* of the survey consists of some of the verbal associations of the students that took part in the survey. The *purpose* of the survey is to reconstruct that part of the associative field of the word "nature" which is related to the biological aspects of the content of the concept of "Nature".

At the end of April 2009, an associative experiment was carried out with 380 students from the 6<sup>th</sup> and 7<sup>th</sup> grade (students at the age of 12 to 14). The experiment was carried out following the S (stimulus) → R<sub>i</sub> (reactions) pattern. Each student was required to write down the first seven words that came to their mind when the word "nature" was pronounced. The students were specifically instructed to try to react spontaneously and quickly without much consideration as to what exactly to write down.

After the end of the experiment, we separated the answer sheets only of the students who were 13 years old. A cross section was compiled on an arbitrary basis. The cross-sectional

data contain the answers of 50 girls and 50 boys from the 6<sup>th</sup> grade and the same number of girls and boys from the 7<sup>th</sup> grade. All words-reactions from the work sheets that had been taken for the cross-sectional data were copied. In this way we got the data about the reactions of 100 students from the 6<sup>th</sup> grade and 100 students from the 7<sup>th</sup> grade; the total number of reactions being 1400.

We compiled a frequency glossary of the words of both groups with the help of a computer program. From this glossary we only took the words-reactions that have a direct connection to the biological aspects of the concept of "Nature". They are 988 ( $\approx 70, 57\%$ ). Only these words are coded and used for the compilation of comparative tables with data for the frequency of the reactions (Tables 2 and 3).

So as to compare two relative frequencies in the study of two independent survey samples the following statistics is used (Гласс и Стэнли, 1976, p. 295):

$$z = \frac{p_1 - p_2}{\sqrt{\frac{f_1 + f_2}{n_1 + n_2} \left(1 - \frac{f_1 + f_2}{n_1 + n_2}\right) \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where:

$n_1, n_2$  – is the volume of the reactions studied ( $n_1$  – of the students from the 6<sup>th</sup> grade;  $n_2$  – of the students from the 7<sup>th</sup> grade);

$f_1, f_2$  – is the absolute frequency of the reactions;

$p_1, p_2$  – is the relative frequency of the reactions;

$$p_1 = \frac{f_1}{n_1}; \quad p_2 = \frac{f_2}{n_2}.$$

The empirical hypothesis is redefined for the purposes of the statistical analysis into statistical hypotheses.

*Hypothesis  $H_0$* : there is no difference between the reactions in the two survey samples.

*Hypothesis  $H_1$* : the reactions in the two survey samples differ.

The calculated value of the quantity  $z$  is compared to the critical value for the chosen level of truthfulness ( $\alpha$ ) which is taken from statistical tables. If the value of  $z$  is smaller than the negative and greater than the positive critical value for the chosen level of truthfulness,  $H_0$  is denied, and an alternative hypothesis  $H_1$  is accepted. Otherwise,  $H_0$  is accepted. For  $\alpha = 0.05$ , the critical values of the quantity are  $z = \pm 1.96$ .

## Results of Research

The results from the survey have been presented in the following tables:

**Table 2. Summarized data from the associative experiment.**

Aspects of studying and comparison features	Frequency of the reactions		Criterion for Differentiation $z$	Frequency of the different reactions		Criterion for Differentiation $z$
	$f_1$	$f_2$		$f_1$	$f_2$	
• standard reactions	428	456	$z = -2,05 < -1,96$ $H_0$ is denied	30	32	$z = -1,19 > -1,96$ $H_0$ is accepted
• reactions in diads	22	12	$z = 1,91 < 1,96$ $H_0$ is accepted	11	6	$z = -0,96 > -1,96$ $H_0$ is accepted
• individual reactions	39	31	$z = 1,08 < 1,96$ $H_0$ is accepted	40	31	$z = 0,56 < 1,96$ $H_0$ is accepted
<i>Total number of reactions:</i>	$n_1$ 489	$n_2$ 499		$n_1$ 81	$n_2$ 69	

Table 2 presents summarized data about the reactions of the students according to the properties of the concept of “Nature” that are listed in table 1. We use a classification of the reactions according to the *level of originating of the answers* (Мартинович, 1993): the reactions are standard (with frequency greater than 2) and individual (with frequency 1), and the words with frequency 2 make up a middle layer within the associative field (in table 2 we have marked them as reactions in dyads).

Table 3 is more informative. On its first horizontal line, we have listed terms or groups of terms reflecting biological aspects of the concept of “Nature”. The second horizontal line has the words (in columns) which can be related by their meaning to the corresponding systems of terms. The digits after each word show the frequency of the reactions for both groups, and, the digits in parentheses correspond to the answers of the students from the 6<sup>th</sup> and 7<sup>th</sup> grade. The third horizontal line shows the frequency of the reactions of the students. The fourth line reflects the total number of the words used, and, the digits in parentheses show the number of words used correspondingly by the 6<sup>th</sup>-grade and 7<sup>th</sup>-grade students. The fifth horizontal line lists the number of words that have been used by both groups of students. The last horizontal line contains the values for the relative quantity  $K$ .

In order to make the interpretation of the data easier, we introduce the relative quantity  $K$ , which shows the ratio between the frequencies of the reactions related to the corresponding systems of concepts and the total number of words reflecting these reactions. The higher values of  $K$  show greater similarity in the frequency of the reactions, that is, they show similar associations in the minds of the students from the groups that have been studied. The low values of  $K$  show a certain deficit of associations.

**Table 3. Words-reactions related to concepts from the syllabus in Man and Nature (5<sup>th</sup> and 6<sup>th</sup> grade) and Biology and Health Education (7<sup>th</sup> grade).**

CONCEPTS	TAXONOMIC GROUPS OF ORGANISMS	ORGANISMS	VITAL PROCESSES OF ORGANISMS	ORGANS AND SYSTEMS OF ORGANISMS	NATURAL ENVIRONMENT	INFLUENCE OF MAN ON THE ENVIRONMENT
Frequency of the reactions in the survey (6 <sup>th</sup> + 7 <sup>th</sup> grade)	<p><u>PLANTS</u></p> <ul style="list-style-type: none"> <li>plant, -s, 71 (28+43)</li> <li>weed, 3 (0+3)</li> <li>oak tree, 2 (2+0)</li> <li>bamboo, 1 (0+1)</li> <li>beech-tree, 1 (1+0)</li> <li>strawberries, 1 (1+0)</li> <li>wild geranium, 1 (1+0)</li> <li>fern, 1 (0+1)</li> <li>linden tree, 1 (0+1)</li> <li>pine, 1 (0+1)</li> </ul> <p><u>FUNGI</u></p> <ul style="list-style-type: none"> <li>fungi, 2 (1+1)</li> </ul> <p><u>ORGANISMS</u></p> <ul style="list-style-type: none"> <li>tree stump, 2 (2+0)</li> <li>flower, -s, 53 (30+23)</li> <li>grass, 44 (29+15)</li> <li>bush, -bushes, 25 (14+11)</li> <li>animate, 14 (10+4)</li> <li>people, 13 (6+7)</li> <li>organisms, 4 (3+1)</li> <li>bio, 4 (2+2)</li> </ul>	<p><u>ANIMALS, MAN</u></p> <ul style="list-style-type: none"> <li>animal, -s, 116 (53+63)</li> <li>man, 23 (7+16)</li> <li>birds 11 (8+3)</li> <li>insect, -s, 4 (1+3)</li> <li>mammal, -s, 2 (2+0)</li> <li>butterfly, -butterflies 2 (2+0)</li> <li>bees, 2 (1+1)</li> <li>frog, 2 (1+1)</li> <li>bat, 1 (1+0)</li> <li>bear, 1 (1+0)</li> <li>beetles, 1 (1+0)</li> <li>woman, 1 (0+1)</li> <li>rabbit, 1 (0+1)</li> <li>reptiles, 1 (0+1)</li> <li>snakes, 1 (0+1)</li> <li>snail, 1 (1+0)</li> <li>wolf, 1 (1+0)</li> <li>fox, 1 (1+0)</li> </ul>	<ul style="list-style-type: none"> <li>life, 14 (6+8)</li> <li>development, 4 (3+0)</li> <li>reproduction, 2 (1+1)</li> <li>feeding, 1 (1+0)</li> <li>photosynthesis, 1 (0+1)</li> <li>breathing, 1 (0+1)</li> <li>blossoming, 1 (1+0)</li> <li>vitality, 1 (1+0)</li> <li>health, 1 (0+1)</li> <li>disease, 1 (0+1)</li> </ul>	<p><u>ORGANS OF PLANTS</u></p> <ul style="list-style-type: none"> <li>leaf, leaves, 20 (12+8)</li> <li>fruit, 7 (7+0)</li> <li>branches, 2 (2+0)</li> <li>blossom, 1 (1+0)</li> <li>pine cones, 1 (0+1)</li> <li>roots, 1 (1+0)</li> </ul> <p><u>ORGANS AND SYSTEMS OF ANIMALS AND MAN</u></p> <ul style="list-style-type: none"> <li>system, -s, 4 (0+4)</li> <li>cell, -s, 3 (0+3);</li> <li>tissue, 1 (0+1)</li> <li>organs, 1 (0+1)</li> <li>nervous (system), 1 (0+1)</li> <li>musculoskeletal (system), 1 (0+1)</li> <li>reproductive, 1 (0+1)</li> </ul>	<p><u>TERRESTRIAL ENVIRONMENT</u></p> <p><u>AIR, SOILS</u></p> <ul style="list-style-type: none"> <li>forest, -s, 58 (12+46)</li> <li>air, 47 (21+26)</li> <li>mountains, 27 (16+11)</li> <li>glade, -s, 22 (8+14)</li> <li>soil, -s, 10 (6+4)</li> <li>field, -s, 6 (1+5)</li> <li>meadows, 5 (1+4)</li> <li>park, 2 (1+1)</li> <li>valleys, 2 (2+0)</li> <li>jungle, 1 (0+1)</li> <li>desert, 1 (0+1)</li> <li>sand, 1 (1+0)</li> <li>soil, 1 (1+0)</li> </ul> <p><u>MARINE ENVIRONMENT</u></p> <p><u>WATERS</u></p> <ul style="list-style-type: none"> <li>water, -s, 46 (25+21)</li> <li>river, -s, 42 (19+23)</li> <li>lake, -s, 19 (7+12)</li> <li>sea, -s, 16 (9+7)</li> <li>waterfall, -s, 6 (4+2)</li> <li>ocean, -s, 6 (3+3)</li> <li>reservoirs, 2 (1+1)</li> <li>brook, 2 (2+0)</li> <li>lagoon, 1 (1+0)</li> <li>spring, 1 (1+0)</li> <li>swamps, 1 (1+0)</li> </ul> <p><u>OTHER</u></p> <ul style="list-style-type: none"> <li>variety, 12 (5+7);</li> <li>cloud, -s, 3 (3+0)</li> <li>rain, 3 (0+3)</li> <li>wind, 2 (0+2)</li> <li>environment, 2 (0+2)</li> <li>world, 1 (1+0)</li> <li>cycle, 1 (1+0)</li> </ul>	<p><u>PROTECTION</u></p> <ul style="list-style-type: none"> <li>protection, 5 (0+5)</li> <li>fertility, 3 (3+0)</li> <li>cleanness, 1 (0+1)</li> <li>preservation, 1 (0+1)</li> <li>agronomy, 1 (1+0)</li> </ul> <p><u>POLLUTION</u></p> <ul style="list-style-type: none"> <li>pollution, 14 (11+3)</li> <li>pollutants, 2 (0+2)</li> <li>not-taken care of, 1 (1+0)</li> <li>waste, 1 (0+1)</li> </ul> <p><u>DESTRUCTION</u></p> <ul style="list-style-type: none"> <li>fire, 2 (0+2)</li> <li>burnt down, 1 (1+0)</li> <li>destruction, 1 (1+0)</li> <li>disaster, 1 (1+0)</li> <li>hunting, 1 (1+0)</li> </ul>
	<p>Number of the reactions</p> <p>Number of words</p> <p>Identical words</p> <p>K</p>	<p>534 (280/254)</p> <p>46 (36/16)</p> <p>26</p> <p>11,60 (7,78/15,87)</p>	<p>26 (13/13)</p> <p>10 (6/6)</p> <p>3</p> <p>2,6 (2,17/2,17)</p>	<p>44 (23/21)</p> <p>13 (5/9)</p> <p>1</p> <p>3,38 (4,60/2,33)</p>	<p>349 (153/196)</p> <p>31 (26/21)</p> <p>16</p> <p>11,26 (5,88/9,33)</p>	<p>35 (20/15)</p> <p>14 (8/7)</p> <p>1</p> <p>2,50(2,50/2,14)</p>

## Discussion

The analysis of the data from the associative experiment shows the following:

1. The statistical analysis shows that the group associative fields do not differ greatly according to the level of originating of the answers. Only the difference between the standard reactions is of statistical importance as far as this feature is concerned.

2. The words-associations which can be related to the biological aspects of the concept of "Nature" are 114 for the unified cross-sectioned data. For the group from the 6<sup>th</sup> grade the words-associations are 81, and for the group from the 7<sup>th</sup> grade, 69 (table 2), which is not a significant difference at first glance. But having in mind the fact that from all the words only 46 (that is, about 41%) have been used by students from both groups, we can say for sure that the difference in the reactions is actually quite significant. What is more, in the cross-sectioned data from the 7<sup>th</sup> grade, there are more standard reactions as words-reactions with the meaning of more general scientific terms, and in the cross-sectioned data from the 6<sup>th</sup> grade, the individual reactions expressed in words-reactions naming more concrete objects are greater in number.

The difference in the standard and individual reactions between the two groups can be explained with the difference in the volume, content and structure of the basic systems of scientific terms (concepts) which function in the process of education in the 6<sup>th</sup> and 7<sup>th</sup> grade.

3. The students from both groups most frequently associate nature with plant and animal organisms: 534 (280/254). We find this similarity of the reactions to be important.

In the group associative fields, the words with greatest frequency are: *animal*, -s, 116 (53+63); *tree*, -s, 108 (60+48); *plant*, -s, 71 (28+43); *flower*, -s, 53 (30+23). These words can be related to the core of the linguistic consciousness because of statistical considerations. (See more information about the method of research in the Bulgarian Associative Dictionary: Караулов, 2003, p. 10).

When comparing only the first associations (words-reactions) of the students from the 6<sup>th</sup> and the 7<sup>th</sup> grade, there is similarity again: the words *tree*, -s, 50 (30+20); *plant*, -s, 20 (7+13) and *animal*, -s, 15 (8+7) are most frequent. These words-reactions (85) comprise 47.5 % of the total number (200) of the first words-reactions of the two groups that took part in the survey.

This confirms the finding from our previous associative experiment that for 13-year-old students the concept of "Nature" has associations with a positive connotation related to the tree as a symbol of life, to the world of animals and plants (Dimova, Angelova, Rusev, 2009).

4. Special attention should be paid to the fact that in the group associative field of the unified cross-sectional data the words *man*, 23 (7+16) and *people*, 13 (6+7) have relatively low frequency. The word *man* is the first association of only 1 student from the 6<sup>th</sup> grade and of 3 students from the 7<sup>th</sup> grade; this word has been written down as a second association by 1 student from the 6<sup>th</sup> and 2 students from the 7<sup>th</sup> grade. We might assume that most of the 13-year-old students who took part in the survey still do not perceive Man as an inseparable part of Nature. This could be the explanation for the fact that there is a small number of associations in the unified cross-sectional data (35) related to the influence of man on nature. We can assume that school work is not focused enough on teaching students to perceive nature as something valuable and important (as we have previously stated, this is one of the main goals set up in the syllabi of "Man and Nature" and "Biology and Health Education").

5. The next thematic group of words-associations can be related to objects from the natural environment. Only a few associations appear with great frequency in this part of the associative fields: *forest*, -s, 58 (12+46); *air*, 47 (21+26); *water*, -s, 46 (25+21) and *river*, -s, 42 (19+23). These words can also be related to the core of the linguistic consciousness of 13-year-old students.

The rest of the words-associations are quite diverse. This could be explained by taking into consideration the life experience of the students obtained from direct contact with nature,

and also by the reflection in their linguistic consciousness of the intra-subject connections created during their education in “Geography and Economics”, “Man and Nature”, “Biology and Health Education”.

6. For the rest of the thematic groups of words-associations, the values of the relative quantity  $K$  are low. The individual reactions dominate.

The summarized data from the associative experiment allow for drawing the following conclusion: the production of associations about Nature (that is, the creation of a field of links between words and images) is achieved by the 13-year-old students in a cultural context which synthesizes spontaneous activeness of images mainly of biological objects and activates knowledge in the form of acquired scientific terms.

### Instead of a Conclusion

The results from the experiment lead us to ask two new interesting questions:

- *Whether there will be similarity or difference when the concept of Nature becomes explicit in various task situations which activate the logical and visual thinking of the students (for example, a semantic evaluation, an image, etc.)*

We looked for an answer to this question through an experiment with students from the 7<sup>th</sup> grade in Secondary School “I. Seliminsky”, Sliven. After the end of the experiment we asked the students what they would draw or tell about if they had the task to describe nature. 74 students readily took part in a painting contest and 10 of them took part in an essay contest. The preliminary data suggest similarity with the results from associative experiment. This finding can be more readily accepted after the examination of more comprehensive cross-sectional data.

- *Whether the cycle of associative thinking in question can provoke in students self-evaluation of their personal knowledge and understanding of nature.*

An answer to this question could be found through the use of an appropriate methodology described by Kostova, Z. and Atasoy, E. (2009): the students are required to self-evaluate their knowledge about the meaning of a certain number of terms.

“Comparisons of the results of teacher and self-evaluation combined with critical and constructive discussion can help students to develop understanding and skills for self-regulated learning in pursuit for excellence” (Kostova, Z. & E. Atasoy, 2009, p. 52).

We could use this idea in some future survey.

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*Advised by Zdravka Kostova, Plovdiv University “Paisii Hilendarski”, Bulgaria*

<b>Yordanka Dimova</b>	Assoc. Professor, Plovdiv University “Paisii Hilendarski”, 24, Tsar Asen Str., 4000 Plovdiv, Bulgaria. Phone: +35932261230. E-mail: dimova@uni-plovdiv.bg Website: <a href="http://argon.uni-plovdiv.bg/">http://argon.uni-plovdiv.bg/</a>
<b>Margarita Panayotova</b>	Assoc. Professor, Plovdiv University “Paisii Hilendarski”, 24, Tsar Asen Str., 4000 Plovdiv, Bulgaria. Phone: +35932261504. E-mail: margopan@uni-plovdiv.bg Website: <a href="http://bio.uni-plovdiv.bg/">http://bio.uni-plovdiv.bg/</a>
<b>Darina Uzova</b>	Teacher, Secondary School “Ivan Seliminsky”, 1, Dragoman Str., 8800 Sliven, Bulgaria. Phone: +359044624774. E-mail: dari_uz@mail.bg