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METHODOLOGY OF PREPARING STUDENTS FOR INTERNATIONAL OLYMPIADS THROUGH SOLUTION OF PROBLEMS RELATED TO THE HARDY-WEINBERG LAW

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ABOUT ARTICLE

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Abstract: This article provides information on the issues of the Olympiad on teaching the topic Hardy-Weinberg Law (Natural selection in mixed populations) from the field of biology. The presented information is aimed at improving the methodology for using Olympiad problems in teaching by combining the basic concepts used in teaching the subject of population genetics with the concepts used in mathematics.

INTRODUCTION

In accordance with the decision of the President of the Republic of Uzbekistan "On measures to identify talented young people and establish a continuous system of highly qualified personnel training" dated May 3, 2019 PQ-4306, starting from the 2019-2020 academic year , the participants who took 1-3 places in the Republican stage of the main Olympiad will be presented with a certificate valid for 3 years, giving the right to receive the maximum score in the entrance exams to state higher education institutions in the field of specialization.

Also, students who took 1st-3rd places in the following international Olympiads are admitted to higher education institutions without a test or an additional exam.

International Mathematical Olympiad (IMO)
International Physics Olympiad (IPhO)
International Chemistry Olympiad (IChO)
International Biology Olympiad (IBO)
International Olympiad in Informatics (IMO)

The status of international and regional science olympiads not included in this list is equal to the Republican stage of the main olympiads and they are determined by the decision of the Cabinet of Ministers.

That is, students who have won all of the 5 international Olympiads listed above will not be allowed to study without a test, but the maximum points will be given only in the subject in which they won. .

For example, if the student who won the Mendeleev International Chemistry Olympiad, who is well known to all of us, applies to the OTM, he will be given the maximum score in chemistry in the tests, but he will have to do the rest of the science blocks himself.

It would not be wrong to call the International Olympiad of Biology the largest and most prestigious forum for young biologists in the world. Every year in July, 500-600 talented young people from more than 100 countries of the world compete, communicate and exchange experience.

Candidates for the national team of Uzbekistan, which participates in prestigious international Olympiads in Uzbekistan, were selected in 3 stages, based on the requirements set by the international Olympiad standards, and the practice of systematically preparing for international Olympiads with students was launched.

The first round of selection of candidates for the national team participating in the prestigious international biology Olympiad took place on November 9, 2022. 267 students from the Republic of Karakalpakstan, Tashkent city and all regions participated in this stage. The participants took part in 3 languages: Uzbek, Karakalpak and Russian. At this stage, the students of Tashkent city, Bukhara region and Navoi region scored the highest points from the assignments.

The II stage of the selection of the members of the national team of Uzbekistan in the prestigious international Olympics was held on February 6-11 of this year.

February 6 - informatics and information technologies

February 9 - biology and chemistry

February 11 - a study of the problems of public education named after A. Avloni and determination of prospects was held in one round of mathematics and physics at the scientific-research institute.

To complete the tasks of the qualifying Olympiad: 4 hours were allocated for biology.

The second stage of selection of candidates for the national team of Uzbekistan participating in the prestigious international biology Olympiads is in the form of a written work, 5 tasks of different difficulty levels are given, each task is evaluated with different points according to the level of difficulty, all tasks have a total of 50 points. evaluated with

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Based on the above quotas in biology, in the event that the scores of several candidates for 12 places are equal, the student who has scored the most points in the assignment with the highest score of the given tasks will be given priority. will have

In case of equal scores for each assignment, students will be given 3 additional open tests (with written answers) by the jury and the winner will be determined.

The III stage of the selection of candidates for the national team of Uzbekistan participating in the prestigious international biology Olympiad is planned to be held on April 29-30 at the regional center for retraining and professional development of public education workers of the Tashkent region.

The order of the III stage of qualifying for the International Olympiads will be held in the following order:

Biology - qualifying Olympiad will be held for 2 days. On the first day, the participants will be given 5 tasks for written work (how the tasks will be evaluated by the jury), all tasks will be evaluated with a total of 40 points. You have 4 hours to complete the tasks. On the second day, the participants will be given a theoretical test and a practical assignment, the assignments will be evaluated with a total of 60 points and 4 hours will be allocated.

The composition of the national team of Uzbekistan, which will participate in the prestigious international biology Olympiad, will be formed, consisting of 4 students who have recorded high results in the sequence of points collected from among the participants.

Professors and teachers of higher educational institutions, as well as trainers who are prize winners of international Olympiads, are involved in the qualifying Olympiads. Experienced teachers and leaders of the national team are constantly organizing master classes and intensive training sessions for the selected students. In particular, in 2022, 6 foreign trainers-teachers who are directly participating in the preparation of the national teams of the United States of America, South Korea, and the Russian Federation for the international Olympiads in mathematics, chemistry, biology, and physics were recruited. They conduct theoretical and practical training with their students online and offline.

One of the important issues of pedagogical research in the development of modern education, which is currently being carried out, is the organization of the teaching process aimed at the correct mastering of problems and exercises from biology and achieving its effectiveness, and thereby making students interested in participating in Olympiads and Olympiads. is to increase.

In increasing the effectiveness of biological education and in achieving the biological goals set by the student to a certain extent, problems occupy a special place in improving mathematical knowledge. That's why the use of more problems in biology lessons and the development of methods of their use is promoted as one of the urgent tasks of biology teaching methodology. The correct implementation of the methodology of solving problems leads to students' acquisition of biological knowledge at a high level and a deep understanding of the mechanism of biological processes.

At present, interdisciplinary connection with mathematics, chemistry and physics through the use of problems in biology classes is considered an urgent topic.

In particular, problems related to the Hardy-Weinberg law (natural selection in panmixed populations) allow students to clearly imagine the mechanisms of biological and mathematical processes.

Below, it is appropriate to get acquainted with the method of solving problems related to the Hardy-Weinberg law given to students at various stages of the selection of candidates for the national team of Uzbekistan at the prestigious international biology Olympiad.

Issue 1: The Vatican is the smallest officially recognized state in the world located in the territory of Rome. As of 2019, the population of the Vatican is 825 people. Among them, 132 people of the first blood group (OO), 396 people of the second blood group (AA, AO), 165 people of the third blood group (BB, BO), and 132 people of the fourth blood group.

Q5.2.1. Calculate the frequency of ABO genes representing blood groups in this population. Write down and explain the solution to the problem in full.

Q5.2.2. Estimate how many people are homozygous for these alleles.

Q5.2.3. Calculate how many people are heterozygous for type III blood.

Solution to the problem:

1) Using the given data, we make the following calculations.

Fenotip	Genotip	Matematik chastota	Hisoblash
A	I^AI^A va I^AI^O	$p^2 + 2pr$	396/825 = 0,48 %
B	I^BI^B va I^BI^O	$q^2 + 2qr$	165/825 = 0,2 %
AB	I^AI^B	2pq	132/825 = 0,16 %
O	I^OI^O	r^2	132/825 = 0,16 %

2) r^2 - I^OI^O because the genotype is recessive homozygous r - O - we can find the allele frequency. $r = \sqrt{r^2}$ can be extracted from the root, i.e $r = \sqrt{0,16} = 0,4$ (O - allele frequency)

3) From the formula for finding the frequency of alleles, i.e $(p + r)^2$ We can find the Hardy-Weinberg formula, i.e $p^2 + 2pr + r^2$

4) $p^2 + 2pr – 0,48$ ga, $r^2 – 0,16$ is equal to

5) 0,48 + 0,16 = 0,64 (I^AI^A, I^AI^O and I^OI^O)

6) $(p + r)^2$ can be extracted from the root, i.e $\sqrt{0,64} = 0,8$ (A va O - frequency of alleles)

7) p = 0,8 – 0,4 = 0,4 (A - allele frequency)

8) q = 1 – (p + r) = 1 – 0,8 = 0,2 (B - allele frequency)

9) Using these frequencies, we can find all genotype frequencies as follows.

Genotip	Matematik chastota	Chastota hisoblash	Chastota
I^AI^A	p^2	$(0,4)^2$	0,16
I^BI^B	q^2	$(0,2)^2$	0,04
I^OI^O	r^2	$(0,4)^2$	0,16
I^AI^O	2pr	2 x 0,4 x 0,4	0,32
I^BI^O	2qr	2 x 0,2 x 0,4	0,16
I^AI^B	2pq	2 x 0,4 x 0,2	0,32

Q 5.2.1. A – 0,4; B – 0,2; O – 0,4

Q 5.2.2. People homozygous for these alleles are IAIA, IBIB, IOIO, and based on this, we add the frequency of each homozygous person.

11) 0,16 + 0,04 + 0,16 = 0,36

12) 0,36 x 825 = 297 people are homozygous for these alleles

Q 5.2.3. III – This is a heterozygous person by blood group - I^BI^O

13) 0,16 x 825 = 132 a person is heterozygous according to III-blood group

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