MECHANISMS FOR IMPLEMENTING INTEGRATION IN THE PROCESS OF SOLVING BIOLOGICAL PROBLEMS AND EXERCISES

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ANNOTATION: The methodology for developing students' professional competence through solving problems and exercises based on an integrative approach in the process of designing biology lessons is described.

KEYWORDS: integrated learning, biology, chemistry, physics, mathematics, problem, exercise, blood density, diffusion, electric field, amount of matter.

By the 20th century, as a result of the differentiated development of all sciences according to the objects of study, new branches of science emerged. In the 21st century, there has been a need for integrated education, and it has become known that integrated education performs important functions. Because it became clear that it is necessary to use the achievements of various disciplines to thoroughly master the fundamentals of a particular science, to fully understand the essence of the content of the phenomena and processes being studied. As with all subjects taught in higher education institutions, problems and exercises in biology are also important in the process of teaching the subject of solving problems.

Integration plays a key role in the process of student learning. Because it requires a multifaceted approach to scientifically substantiating each biological phenomenon. When studying the course of biological processes, it is also necessary to use knowledge related to chemistry, physics, and mathematics:

- when solving problems and exercises, the knowledge gained in chemistry is used to study the chemical composition of bones and the properties of salts;
- based on the knowledge gained in physics about the mechanism of bone movement in joints, mechanical work performance, and friction force;
- knowledge of gas exchange in the lungs and tissues, blood's transport function, and oxidation is studied in connection with chemistry;
- knowledge of diffusion in gases and liquids, atmospheric pressure is based on knowledge acquired in physics;
- when explaining the mechanism of inhalation and exhalation, blood pressure, knowledge of physics is used in the study of information about the laws of motion depending on the pressure difference in liquids and gases;
- enzymes, catalysts, acidic, alkaline, and neutral reactions of the medium are studied based on knowledge acquired in chemistry in the study of plastic and energy exchange, students use chemical knowledge to solve problems related to the law of conservation and transformation of energy from one species to another to draw conclusions about the unity of life in living and nonliving nature;
- the formation of the concept of heat regulation is based on the knowledge gained in physics about specific heat in steam generation;
- the functions of the eye, which is the organ of vision, are explained based on optical knowledge.

It is important to compile tasks for the development of students' creative thinking in the subject "Solving Problems and Exercises in Biology (Human and Health)." Predicting biological outcomes is a prerequisite for a problematic approach to learning.

Even if causal relationships are taken into account when constructing exercises, it will be possible to predict the results under certain conditions. In problems, when establishing causal relationships, the cause of a particular consequence is determined, and when forming a problem, it is considered to determine its result when something causes it. Practicing students in constant problem-solving allows for a broader understanding of the essence of the topic, understanding the interconnectedness of causes and consequences. Because problem-solving is the most important way of thinking.

Any actions taken by students with the goal of practicing problem-solving encourage students to engage in scientific research and scientific discoveries. When creating problems based on scientific research, it is relevant to ask students to imagine themselves as "scientists" and to demand that they express

some opinion on the scientific issue.

The role of interdisciplinary connections with physics, mathematics, chemistry, and other natural and exact sciences in the processes of studying topics related to solving biological problems and exercises, activating students' cognitive activity, using acquired knowledge in new unexpected situations, and enhancing the professional competence of future biology teachers through solving biological problems is invaluable.

Exercise 1. The average human weight is 60 kg. Blood constitutes 8% of body weight, blood density p=1.050 g/cm^3, hemoglobin (Hb) content in 100 ml of blood is 14 g, 1 g of hemoglobin binds to itself approximately 1.34 mg of oxygen. Calculate how much oxygen the blood carries through one round of the body.

Analysis of the exercise:

The goal is to explain to students the role of hemoglobin in the process of gas metabolism in the human body. Given that all blood passes through the lungs and is saturated with oxygen, to answer the question in the task, it is first necessary to calculate the amount of hemoglobin in the blood of a person weighing 60 kg and how much oxygen hemoglobin binds to itself.

Given:

(body weight) m=60 kg

blood content = 8%

(blood density) *p*= 1.050 g/cm^3

100 ml of blood contains (Hb) = 14 g

1 g of hemoglobin (O_2) = 1.34 mg

m (O_2) =?

1ml = 1cm^3

Solution:

1) How much blood does a person weighing 60 kg have?

m (blood) = 60 (kg) · 0.08 = 4.8 kg = 4800 g of blood.

2) We achieve the goal by mobilizing knowledge gained in physics to find the volume of blood? V=m: p

V = 4800 (g): 1.05 (g/cm3) = 4571cm^3 = 4571ml

3) After that, how much hemoglobin is found in 4571 ml of blood?

If 14 g of hemoglobin (Hb) is present in ~~100~~ ml,

4571~~ ml~~ contains x g of hemoglobin (Hb).

x=4571 (ml) · 14 (g): 100 (ml) = 639.94g hemoglobin (Hb)

4) Determine how much oxygen the human body carries during one blood cycle.

m (O_2) = 639.94 (g) · 1.34 (mg/g) = 857.5 mg = 0.857g O_2.

Answer: A person weighing 60 kg carries 639.94 g of hemoglobin in their blood and 0.857 g of oxygen during one round of the body.

Chemical exercises The use of tasks that integrate chemistry and biology to test students' knowledge of biology and chemistry increases their interest in biology and chemistry. Such questions, first and foremost, teach students not to forget about chemistry when studying biology.

Exercise 2. The average life capacity of a person's lungs is 3500 cm^3. If a person breathes an average of 16-20 times per minute, find the amount of O_2 and CO_2 in the air passing through the lungs in an hour. Find the solution to the problem, taking into account that the amount of O2 in the air is 21%, and the amount of CO_2 is 0.03%.

Analysis of the exercise:

Objective: The average life capacity of a person's lungs is 3500 cm^3. If a person breathes an average of 16-20 times per minute, find the amount of O2 and CO_2 in the air passing through the lungs in an hour. It is necessary to calculate that the amount of O_2 in the air is 21%, and the amount of CO_2 is 0.03%. When solving this type of problem, the teacher and students should rely on the knowledge they have acquired in chemistry and physics.

Given:

(Lungary life capacity) -V = 3500 cm^3

(Time) -t = 1 hour

(number of breaths) -f = 16

C (O_2) = 21%

C (CO_2) =0.03%

Avogadro number = 22.4 l/mol
The content of O_2 in mol = 32 g/mol
The amount of CO_2 in moles is 44 g/mol
V (CO_2) -?
V (O_2) -?
m (O_2) -?
m (CO_2) -?
Solution:
1)What is the amount of air a person breathes in an hour?
V air = 3500 (cm^3) ·16 (min) · 60 (min) = 3360000cm^3 = 3360 l
2) How much oxygen is in the air you breathe?
V (O_2) = 3360 · 0.21 = 705.6 L
m (O_2) = 705.6 (L) · 32 (g/mol): 22.4 (L/mol) = 1008g
3) How much CO_2 does your breathing air contain?
V (CO_2) = 3360 (L) · 0.0003 = 1.008 L
m (CO_2) = 1.008 (L) · 44 (g/mol): 22.4 (L/mol) = 1.98g
Answer: The amount of O_2 is 1008 g, and the amount of CO_2 is 1.98 g.

Complex biological problems are solved based on mathematical knowledge. Such tasks serve to develop mathematical literacy in teachers or students from basic competencies.

Exercise 3. A particular DNA fragment contains a total of 960 hydrogen bonds. The ratio of the number of hydrogen bonds between adenine and thymine to the number of hydrogen bonds between guanine and cytosine is 1:1.5, respectively. If 50% of the nucleotides in this DNA were lost by mutation, how many nucleotides were lost in the DNA after mutation?

Solution:

1) Taking into account that the ratio of the number of hydrogen bonds between adenine and thymine to the number of hydrogen bonds between guanine and cytosine is 1:1.5, the following operations are performed:

If there are 960 hydrogen bonds in a 2.5 ratio,
There are x = 384 hydrogen bonds in a ratio of 1 (between A and T)
If there are 960 hydrogen bonds in a 2.5 ratio,
There are x = 576 hydrogen bonds (between G and C) at a ratio of 1.5
2) Since there are 2 hydrogen bonds between nucleotides A and T, we divide 384 by 2,
384: 2 = 192 A and 192 T nucleotides.
3) Because there are 3 hydrogen bonds between the G and C nucleotides, we divide 576 by 3,
576: 3 = 192 G and 192 C nucleotides.
4) Add all the nucleotides in the DNA.
192 + 192 + 192 + 192 = 768 nucleotides in a DNA molecule,
5) 100% 768 nucleotides,
50% x = 384 nucleotides were mutated.
Answer: The number of nucleotides in DNA decreased by 384 after the mutation.

The implementation of interdisciplinary integration by biology teachers and students in the process of solving biological problems at all stages of the lesson serves as the foundation for expanding their professional competence, scientific worldview, and the formation of basic and subject-specific competencies.

In addition, many biology questions focus on analyzing the relationship between various influences and processes in living nature. Examples of such problems include the functions performed by the structure, the way of life with the structure, the mutual ecological connections of different living organisms, etc. Problems and exercises of this type can also include problems where the solution to the problem is found by various methods.

The use of physics-related tasks in the process of improving the professional competence of future biology teachers in the process of teaching the subject of solving problems and exercises in biology also yields positive results.

Exercise 4. What is the difference between the voltage and potential of the electric field in the membranes of a nerve cell at rest? (The voltage of an electric field is a force that is the only electric charge that arises in the membrane).

The problem is solved as follows: the potential difference on both sides of the membrane (around

100 mV) should be divided by its thickness (25 mmk).

The answer is very surprising: 4 million volts/m, or 4 thousand volts/mm.

Questions related to biology and chemistry serve to verify students' knowledge of biology and chemistry and increase their interest in biology and chemistry.

An example of a problem that connects chemistry and mathematics with biology is the following.

Exercise 5. A mixture containing ADP and ATP yielded 0.5 mg/mol of adenine and 1.2 mg/mol of phosphate. How many mg/mol ATP does the mixture contain? How many mg/mol of glucose must be decomposed in an oxygenated medium to obtain this amount of ATP from ADP?

Solution: when 1 mole of ADP is broken down, 1 mole of adenine and 2 mole of phosphoric acid are formed, and when 1 mole of ATP is broken down, 1 mole of adenine and 3 mole of phosphoric acid are formed. Let's denote the mg/mol amount of ADP by x, and the mg/mol amount of ATP by y, and write this system as two equations.

$x + y = 0.5$

$2x + 3y = 1.2$

Solving this system, we get $x = 0.3$ mg/mol and $y = 0.2$ mg/mol. To know how much glucose to add to the mixture, we need to divide 0.2 mg/mol by 38. As a result, it becomes known that more than 0.005 mg/mol of glucose is needed.

For a more complicated problem, we can take the following problem:

As a result of the decomposition of a certain sample of DNA into an inorganic substance, 0.37 mg/mol of ammonium and 0.1 mg/mol of phosphoric acid were formed. How many mg/mol of adenine, thymine, guanine, and cytosine were in the DNA? The book can be used to solve this problem.

By looking at the book, we can see that there are 5 nitrogen atoms in one molecule of adenine, 5 nitrogen atoms in guanine, 3 nitrogen atoms in one molecule of cytosine, and 2 nitrogen atoms in thymine. Thus, the A-T pair contains 7 nitrogen atoms and 2 phosphate groups, while the G-C pair contains 8 nitrogen atoms and 2 phosphate groups

Let x denote the number of mg/mol in adenine (the same number of moles as thymine), and y denote the number of mg/mol in guanine, and formulate an equation.

$2x+2y=0.1$

$7x + 8y = 0.37$

Solving this equation yields the following result:

$x = 0.03$ mg/mol and $y = 0.02$ mg/mol.

Examples include the following complex tasks that teach students to improve their professional competence and creative thinking.

Exersice 6. Given that the DNA molecule has three hydrogen bonds between guanine and cytosine, and two hydrogen bonds between adenine and thymine, there are 1,400 pairs of nucleotides in this fragment. Then, if the guanine-cytosine pair is 2.5 times greater than the adenine-thymine pair, what is the number of hydrogen bonds in this chain?

Solution:

$1400 = 2800$

$2800 = 2$ x (A and T) $+ 2.5 \cdot 2$ x (G and C)

$2800 = 7x$

$x = 400$

400 adenines are complementary to 400 thymines, with 800 hydrogen bonds between them.

$400 \cdot 2.5 = 1000$

1,000 guanines are complementary to 1,000 cytosines, with 3,000 hydrogen bonds between them.

$800 + 3000 = 3800$

Answer: There are 3,800 hydrogen bonds.

In conclusion, it can be said that the development of professional competence of future biology teachers through solving problems and exercises in biology, the completion of tasks related to finding errors in the textbook text, the use of tasks, exercises, and tasks that implement interdisciplinary integration play an important role in increasing students' interest in the subject and cognitive activity. It is also an important stimulus for understanding the essence and causes of life processes in living organisms, the relationships and connections between them.

REFERECES:

[1] Yohanes R.S. Pengembangan Model Pembelajaran Matematika untuk Mengaktifkan Otak Kanan Unpublished Disertation. – Surabaya: UNESA, 2007. – 108 h.

[2] Маликов Т.С. Соотношение интуиции и логики в математике и ее обучении: монография. – Алматы: НИЦ «Гылым», 2002. – 166 с.

[3] Raxmatov U.E, G‘ofurov A.T, Fayzullayev S.S, Genetikadan masala va mashqlar yechish. Toshkent. 2022. –260 b.

[4] Shaxmurova G.A., Azimov I.T., Raxmatov U.E. “Biologiyadan masala va mashqlar yechish” O‘quv – qo‘llanma. –Toshkent: “Sano – standart”, 2017. –260 b.

[5] Shakhmurova G.A., Azimov I.T., Rakhmatov U.E., Akhmadaliyeva B.Sh. Solution of biological problems and exercises (human and health). Teaching - methodological guidance. "Literature sparks". T., 2017. 156 p. [in Uzbek].

[6] Shakhmurova G.A., Azimov I.T., Rakhmatov U.E. Problem solving from biology (zoology). Teaching - methodological guidance. Brok Class Servis LLC. T., 2016. 132 p. [in Uzbek]

[7] Raxmatov U.E. Biologiyadan masala va mashqlar yechish. Darslik. –T., 2024. –300 b.

[8] Щукина Г.И. Активизация познавательной деятельности учащихся в учебном процессе. – М.: Просвещение, 2019. – 77 с.

[9] Дворяткина С.Н., Щербатых С.В. Роль системы дополнительного профессионального образования в развитии нового стиля мышления современного специалиста (на примере переподготовки учителя математики) // Психология образования в поликультурном пространстве. – 2019. – №3 (47). – С. 76–88.

[10] Raxmatov, U. (2024). Integrativ yonashuv asosida biologiyadan masala va mashqlar yechish fanini o‘qitishning nazariy asoslari. News of UzMU journal, 1(1.2. 1), 178-181.

Ergashevich, R. U. (2024, January). Methodological principles of professional competence development of the future biology teacher. In International Scientific and Current Research Conferences (pp. 1-5).