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Methodology For Solving Problems of Food Chains and Ecological Pyramids and Its Significance

Ravshanova Umida Baxriddinovna,
Termez State University, Teacher. Surkhandarya, Uzbekistan
Fozilov Sherzod Musurmonovich
Basic doctoral student of the National University of Uzbekistan

Abstract. In this article, you will find various computational problems and exercises, as well as how to work them, as well as suggestions for working on topics related to food chains or ecological pyramids. presented, problem solving in these topics is integrally related to the extent to which theoretical knowledge has been mastered. If the student does not have the necessary theoretical knowledge of the food chain or ecological pyramids, he will not be able to solve any problem or exercise independently. Therefore, some of the information needed to solve food chain problems is explained in a simple form.

Key words: producers, consumers, reductants, autotrophs, heterotrophs.

In nature, each species uses only a part of the energy of organic matter. Substances unsuitable for this species, but still rich in energy, are used by other organisms. Thus, in the course of evolution, in biogeocenoses, species are connected to each other like a chain, they extract material and energy from the original food one by one. Such connections between individuals of species are called food chains. Several interconnected species or organisms, the first of which is food for the next, is called a food chain. A food chain is the transfer of plant energy through a series of organisms by one species eating another. Thus, a food chain is a trophic link between species. (Greek "trophe" - nutrition). Different food levels in an ecosystem are called trophic levels. The first link of the food chain is autotrophic plants (producers). In the process of photosynthesis, they convert solar energy into energy of chemical bonds. The second link consists of herbivorous (primary consumers) and carnivorous (secondary consumers) animals or consumers. The third link of food chains is formed by microorganisms (reductants) that decompose organic substances into mineral substances. In nature, the food chain usually consists of 3-4 levels. When moving from one level to another , the amount of energy and matter decreases by about ten times, because about 90% of the received energy is used to support the vital activity of organisms. The remaining 10% is used for the structure of the organism's body. Due to this, the number of individuals progressively decreases at each subsequent food level. For example, on average, an animal that eats 1000 kg of plants can increase the biomass of predators that eat herbivores up to 10 kg, while that of secondary predators increases only up to 1 kg [6;7].

Thus, there is a progressive reduction of substances and energy at the nutritional level [5] . This law is called the ecological pyramid rule. The ecological pyramid is an indicator of the ratio of biomass and energy in producers, consumers and reducers. The base of the pyramid is made up of autotrophic organisms - producers, above them are herbivores, even higher are carnivores, and at the top of the pyramid are large predators [4] .

Solving issues related to food chains or ecological pyramids in biology classes has educational value. Problem solving helps students apply their theoretical knowledge in practice, develops their thinking skills and science-related competencies. Students fully understand the content of problems and exercises through certain laws and algorithmic consistency [1,2,3]. In addition, the integration of biological science with mathematics, physics and chemistry is carried out. The teacher's teaching to solve problems and exercises should begin with giving them thorough and comprehensive knowledge. In order for the students to master the knowledge according to the requirements of the program, during each topic, the teacher does not give ready-made knowledge by showing charts, films or video lessons, but by dividing the educational material into parts (fragments), it is necessary to increase their activity.

The degree of mastery of the academic subject is determined not only by theoretical knowledge, but also by the ability to apply the acquired knowledge in different situations. If a student doesn't know how to

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solve a math problem, it shows that he doesn't know math. Even if he knows all the theorems and laws. Unfortunately, many people do not understand that this also applies to biology. The knowledge acquired by students is not determined by the amount of biological terms that we demand from students, but also by their ability to apply them in problem situations.

and exercises presented in the article are developed in accordance with the current curriculum and work program. The solution of the problems from different areas of biology allows to study biological laws, the correct use of nature's gifts, the biology and ecology of individual animals and plants in depth. The article also briefly describes the conditions, working methods, solutions and gives methodical instructions. Solving problems from biology allows students to strengthen and develop their scientific worldview, logical thinking, and knowledge gained from all biology lessons.

Let's look at the methods of processing problems related to food chains or ecological pyramids.

Issue 1. The ecological pyramid consists of potato, Colorado potato beetle, chittak and lion. If the lion's feed contains 40% lipid, and the amount of energy released from it is 1860 kcal , determine the total mass of organic matter in potatoes (t).

Solution: We write the food chain:

Potatoes - Colorado beetle – Chittak - Lion is 40% lipid

The amount of energy released from the lipid is given. We know that 1 g of fat produces 9.3 kcal of energy. We can determine how much fat produces 1860 kcal of energy:

$$\begin{array}{l} 1 \text{ —— } 9,3 \\ X \text{ —— } 1860 \end{array} \Big| \quad X=200$$

If the lipid in the lion's body is 200 g and it makes up 40% of the total organic matter, we can determine the total organic matter:

$$\begin{array}{l} 200 \text{ ——— } 40\% \\ X \text{ ——— } 100 \end{array} \Big| \quad X=500$$

500 g is the total organic matter in the lion's body, we follow the ecological pyramid rule to determine the substances in potatoes. Potatoes contain 500,000 g, that is , 0.5 tons of organic matter.

Answer: 0.5 t

Issue 2. In the ecological pyramid, the food chain consists of wheat, grasshopper, lizard, white stork and crocodile. The amount of energy separated from the protein in the white stork's body is 8448 kJ and it is 40% of the total organic matter. If 1/3 of the total organic matter in the bird's body is fat, determine the amount of energy released from the carbohydrate in the wheat (kJ).

Solution: If the amount of energy released from the protein in the white stork's body is 8448 kJ, we determine the mass of the protein:

$$\begin{array}{l} 1 \text{ g} \text{ ——— } 17.6 \text{ kj} \\ X \text{ ——— } 8448 \text{ kj} \end{array} \Big| \quad X=480\text{g}$$

480 g of protein is 40% of the total organic matter, we determine the mass of the total organic matter:

$$\begin{array}{l} 480 \text{ g} \text{ ——— } 40\% \text{ kj} \\ X \text{ ——— } 100 \text{ kj} \end{array} \Big| \quad X=1200\text{g}$$

1/3 of the total organic matter is lipid, its mass

1200:3=400 g.

to us the mass of protein and fat in the body of the white stork. We determine the mass of the carbohydrate:

1200-(480+400)= 320 g of carbohydrates

The mass of carbohydrates in a wheat plant increases to 320,000 g according to the ecological pyramid rule. We determine the energy released from it:

320 000 *l7 .6 =5632000 kJ

Answer: 5632000 kJ

3. According to the rule of the ecological pyramid, the food chain consists of wheat, locusts, grasshoppers, and foxes. 2112 kJ of energy was released from the protein in the rat's body. If protein is 30% of the total organic matter in the body of wheat, determine the total organic matter (kg) in the body of wheat (a). If 40% of the total organic matter in the wheat body is glucose synthesized in the chloroplasts, how much ATF energy (kJ) was expended (b)?

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Solution: If the amount of energy released from the protein in the body of the snail is 2112 kJ, we determine the mass of the protein:

1 g ——17.6 kj
X ——2112 kj | X=120g

If 120 g of protein is 30% of total organic matter, we determine the mass of total organic matter:

120g ——30%
X ——100% kj | X=400g

A) we find the total organic matter in the body of wheat in kg.

According to the ecological pyramid rule, wheat contains 4000 g, i.e. 40 kg of organic matter.

B) if glucose makes up 40% of the total organic substances in the body of wheat, we determine its mass:

40,000 ——100%
X ——40% kj | X=16000

We determine the ATF energy (kJ) produced as a result of photosynthesis. In this process, when one mole of glucose is formed, 18 moles of ATF-720 kJ (18*40) energy is also formed . If 16000 g of glucose is formed, we determine how much ATF is synthesized:

180g ——8 mol
16000 ——X | X=1600 mol

1600 x 40=64000 kJ

Answer: a) 40 kg b) 64000 kJ

Issue 4. In the food chain there are cabbage, white butterfly worm, minnow, wolf. Lipid in the body of the brain makes up 20% of organic substances, and the amount of energy released from it is 7780 kJ. Determine the amount of energy (kcal) released from protein and carbohydrate in the body of the white butterfly worm .

Solution: If the amount of energy released from the lipid in the brain body is 7780 kJ, we determine the mass of the lipid:

1g ——38.9 kj
X ——7780 kj | X=200 g

If 200 g of lipid is 20% of total organic matter, we determine the mass of total organic matter:

200g ——20%
1000g ——100% | X=1000 g

The remaining 80% of organic matter is carbohydrates and proteins. The combined mass of protein and carbohydrate in the white butterfly worm is 8000 g. 1 g of protein and carbohydrate is equal, that is, it produces 4.1 kcal of energy . Let's determine how much energy 8000 g of protein and carbohydrates will produce:

8000x4.1 = 32800 kcal

Answer : 32800 kcal

Conclusion

Problems of various forms develop the student's logical thinking, especially to teach students to retain biological concepts in memory, to study science in depth and to apply it in practice. In addition, problems and exercises make the lesson interesting and meaningful. The problems have a great educational value for students, they ensure positive changes in the student, that is, determination, seriousness, freedom, responsibility in his work, discipline, neatness and readiness for any difficulties.

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