# Teaching And Learning Biochemistry - Fundamental Discipline in the Study of Life Sciences – Based on the Current Psychology of the Student

**Nuţi Aramă[1], Maria Vîrlan[2], Roxana-Angela Tucaliuc[3]**

**Abstract:** This paper is a new approach, based on current psychology of the student, to the teaching and learning of Biochemistry as a fundamental discipline in the study of life sciences. The integration of the studied material is done by adapting its complexity to the current context and has as a first objective the students to realize that the notions of biochemistry are essential in the study of life sciences.

**Keywords:** teaching and learning; biochemistry; innovative approach; current psychology

This paper is a perspective on the study of *Biochemistry*, together with students from the University of Life Sciences - Faculty of Animal and Food Resources Engineering, Iasi.

According to the curriculum, *Biochemistry* is a fundamental discipline in the Animal Science specialization, first year, first and second semesters. The type of assessment is a written exam.

[1] Psychologist professor, CJRAE, Galati, Romania, Address: Marina High School Boarding School, Portului Street 55, Galati 800211, E-mail: arama.nuti@upsc.md.
[2] Professor PhD, Ion Creanga State Pedagogical University of Chișinău, Republica Moldova, Address:Str. Ion Creangă 1, Chișinău, Republica Moldova, virlan.maria@upsc.md.
[3] Lecturer PhD, Iasi University of Life Sciences, Romania, Address: Mihail Sadoveanu Alley no. 3, Iasi, Romania, 700490, Corresponding author: roxana.tucaliuc@iuls.ro.

Biochemistry is an interdisciplinary science, at the intersection of chemistry and biology, which study the chemical processes related to the existence of living organisms or occurring in living organisms.

*Chemistry, Biology* and *Biochemistry* are related disciplines and provide a solid foundation for understanding modern science and involve abstract concepts and complex details that can be difficult to understand and remember.

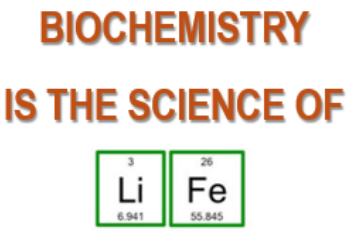


**Figure 1. Biochemistry - Interdisciplinary Science**

Recently, it has been noted that first-year students are encountering difficulties in studying *Biochemistry*, a situation due to the current context:

- the reorganization of school curricula, which led to a reduction in the number of hours allocated to these subjects in high schools and, implicitly, in the time needed to explore concepts in depth and carry out experiments;

- the complexity of the informations involves and requires a variety of elements and relationships that must be understood and managed (requires a thorough understanding of several concepts);

- lack of interest of students, as this subject may be considered too complicated or unimportant for their future, a situation that leads to low motivation to learn;

- insufficient resources, such as inadequately equipped classrooms and laboratories, can limit the integration of concepts and practical experiences, which are essential for a thorough understanding of these subjects.

- teaching methods require continuous adaptation of the teaching to students needs in order to stimulate their interest, develop practical and research skills, and integrate modern technologies into the information covered.

From the first course is necessary for students to understand that biochemistry concepts are essential and they contribute significantly to animal health and productivity through the following fundamental processes:

- optimizing nutrition, like understanding the nutritional needs of animals and formulating balanced diets that stimulate growth and production;

- preventing and combating animal diseases;

- assisted reproduction, through artificial insemination and embryo transfer, which improve genetic quality;

- metabolism, for monitoring and adjusting growth conditions, respectively to maximize the efficiency of meat, milk, and other animal product production.

In order to understand these aspects and assimilate and acquire the necessary concepts, the study of *Biochemistry* is structured in two main chapters, which integrate subchapters (Wohlleben, 2021; Trincă, 2014):

Chapter I: *Descriptive Biochemistry* studies the chemical composition, structure and properties of the main biochemical compounds in living organisms.

Chapter II: *Dynamic Biochemistry (Metabolic Biochemistry)* studies the transformations of biochemical compounds within the living organisms.

Elements of *Descriptive Biochemistry* (carbohydrates, lipids, proteins, vitamins, enzymes) are indispensable for understanding the concepts of *Metabolism* (biosynthesis and biodegradation of compounds in living organisms).

For this, various educational strategies are required to adapt the information into an accessible, attractive format for students' interest in *Biochemistry* (Mih, 2010; Neașu, 2018).

- interactive teaching (using presentations that include animations and various simulations, which can help students better understand abstract concepts),

- learning by project (stimulates creative thinking and the ability to find innovative solutions);

- developing spectacular and attractive practical laboratory work;

- use of technology (access to online applications and platforms that allow students to interact dynamically and personally with the materials provided).

The first chapters, Carbohydrates, Lipids, Proteins, Vitamins and Enzymes provide an abundance of concepts, theories, and structures that are difficult for students with lack in their chemistry knowledge, which makes it imperative for teachers to be patient and persistent in explaining the fundamental role these compounds play in

the host organism. Figure 2 shows the simplest structures for glucose, sucrose, and starch.

An effective method for capturing student interest is based on animations that illustrate the structure and functions of these compounds, how they form and break down and role in organisms.

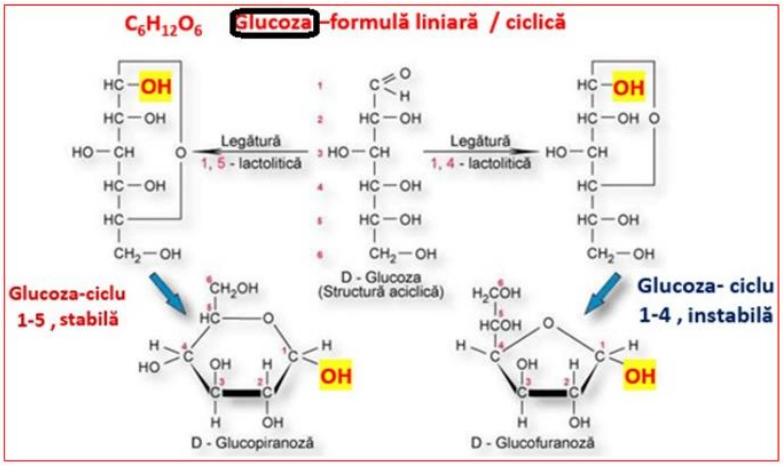


**Figure 2. General Structures for Carbohydrates**

The chapters presented, provide a lever to *Metabolic Biochemistry*, which highlights and demonstrates through complex and logical diagrams that animal and human organisms need energy to survive, provided by food (the compounds studied in *Descriptive Biochemistry*). Figure 3 shows a metabolic pathway involving glucose.

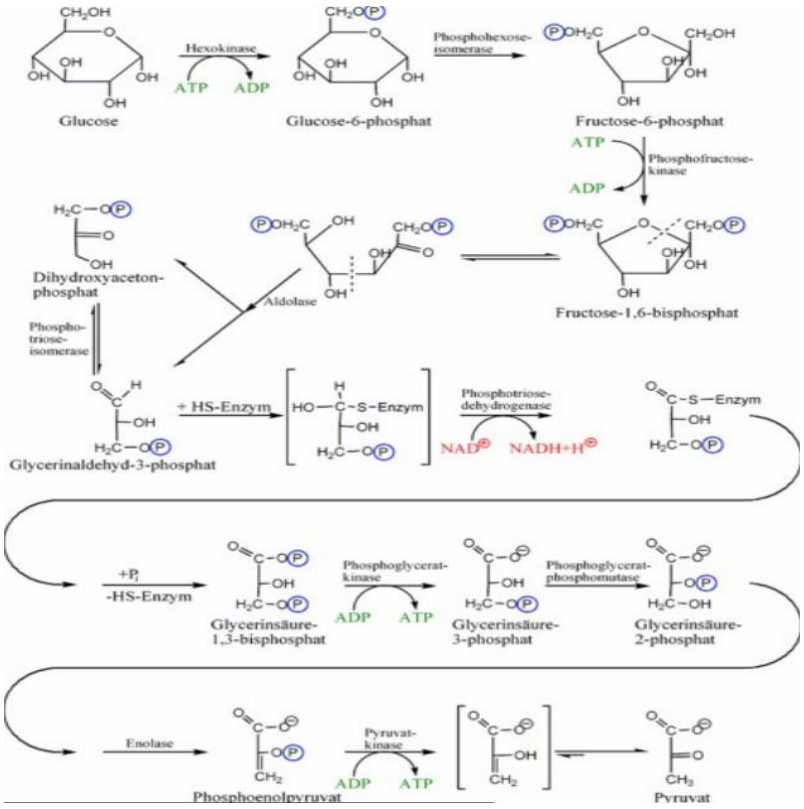


**Figure 3. Formation of Pyruvic Acid, in the Process of Anaerobic Degradation of Carbohydrates**

We recognize the complexity of such schemes and for this reason, this chapter will focus on the *Law of Conservation of Energy*: the energy brought into the living organism is equal to the energy expended by it, so nothing is lost and weight remains constant. When the energy (calories) provided by food exceeds the organism's expenditure, the excess is stored, because the organism is equipped with means of storing energy, both at the cellular level (the unit of measurement is the ATP molecule) and at the level of organs and tissues.

Carbohydrate metabolism is essential because carbohydrates are the main source of energy for organisms. Carbohydrates are metabolized into glucose, which is transported to tissues and stored as glycogen (the organism's glucose reserve), which is converted back to glucose when needed.

**1 gram of carbohydrates generates 4 kcal**

In lipid metabolism, reaction patterns justify:

- lipids represent the organism's energy reserve, as they release a greater amount of energy;

- excess nutrients (carbohydrates, proteins) are largely converted into lipids and stored in the corresponding tissues.

**1 gram of lipids generates 9 kcal**

Proteins can be used as energy after they have been converted into glucose in a process called gluconeogenesis.

**1 gram of protein generates 4.1 kcal**

Calories are the unit of measurement for energy in the organism (a kcal is the amount of energy or heat needed to raise the temperature of one gram of water by one degree Celsius).

Food, depending on the amount of compounds it contains, has a total number of kcal, as shown in the example:

| A packet of oat flakes contain: |
| --- |
| 2 grams of lipids (9 kcal x 2 grams = 18 Kcal) |
| 4 grams of proteins (4 kcal x 4 grams = 14 Kcal) |
| 32 grams of carbohydrate (4 Kcal x 32 grams = 128 Kcal) |

**Figure 4. Calculation of Kcal Corresponding to a Packet of Oat Flakes**

The organism burns calories from oatmeal through metabolic processes and breaks down carbohydrates into glucose, fats into glycerol and fatty acids and proteins into amino acids. These smaller molecules are then transported through the blood to the cells, where they are either absorbed immediately or sent to be used in the final stages of metabolic processes, where they react with oxygen and release energy.

In conclusion, the study of *Biochemistry*, is done by adapting the complexity of the subject to the current context. The material provided to students is in an accessible and attractive format and aims to make students aware of the importance of this subject. Each chapter will highlight the fundamental role of the concepts presented for the animal organism, respectively the role of this information for the easy

understanding of the subsequent chapters. Emphasis will be placed on the use of animations and illustrations to facilitate the process of understanding and memorizing the material. Pointing out the logical parallels between the concepts covered is an added benefit and a welcome framework for directing the material in an easy and logical way.

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