

International  
Journal of  
**Human  
Sciences  
Research**

**HAIR: ITS STRUCTURAL  
DIVERSITIES AS A  
CHEMISTRY TEACHING  
TOOL**

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**Abstract:** The present work was developed during the Pedagogical Residency Program, being an Internship project for undergraduate students. During the Program, students planned and carried out classes, where the lesson plan “Hair: Its Structural Diversities as a Chemistry Teaching Tool” was one of them. Due to the pandemic scenario that the population was facing, classes were taught as an Emergency Education regime, as it was not possible to define when the isolation would end. The lesson plan for Cabelos was divided into three meetings, all classes were applied Virtually, through the Google meet and Zoom platforms. Using a common theme, such as Hair, and unveiling its structure through Chemistry, provided high school students with a vision of its importance, and how this subject is more present in their lives than they imagined.

**Keywords:** Pedagogical Residency, Virtual Teaching, Hair, Chemistry, Social.

## INTRODUCTION

In High School, Chemistry is always seen as a difficult and distant subject from everyday life, “Why must I learn this?”, “I will never use it in my life”, are typical phrases of a teenager who is in High School. Unfortunately, as students we once were, we know that Chemistry is not approached in an interdisciplinary way and/or contextualized with the students’ daily lives, which really makes it difficult for them to learn, and for the teacher to transmit knowledge. The purpose of the lesson plan was precisely to bring Chemistry closer to the students’ daily lives, with a very common theme, Hair.

For the application of the classes, virtual teaching tools and a lot of creativity were used. The main theme was to demonstrate the chemical composition of the hair strand, explain through chemistry why there are straight and curly hair, what happens when the

hair is straightened, and what is the nutritional need of each strand. As classes were developed at the beginning of the Pandemic, teaching technologies were of paramount importance, Program participants took online courses for improvement.

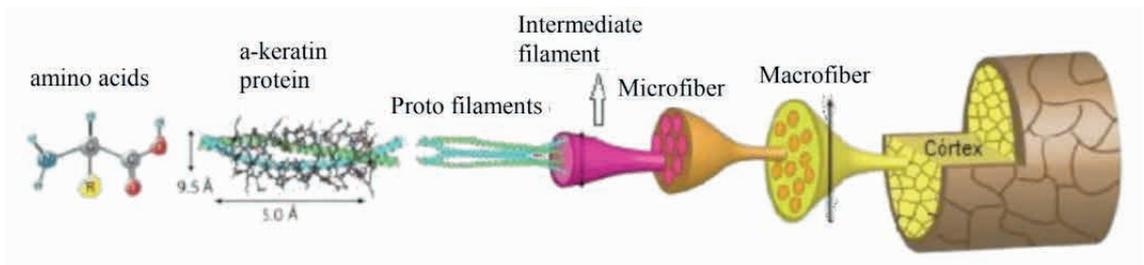
## STRUCTURE OF THE HAIR THREAD AND ITS CHEMICAL COMPOSITION

In class 1, the subjects were approached in a relaxed way, with many contextualized examples and with the application of a questionnaire via Google Forms, to verify if the content was actually learned.

In the third year of high school, some concepts of organic and thermochemistry are covered. The capillary structure was used to demonstrate the main components that make up the thread: Proteins, which in turn are formed by several types of amino acids, and their interactions that give rise to the thread, such as hydrogen bonds, which form bridges of disulfide and which finally determine the shape of the hair, from straight to curly.

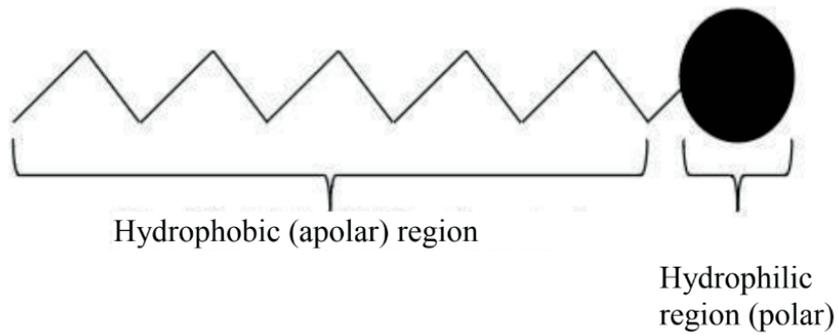
Still on capillary structure, the first class addressed the functions of Proteins, Lipids and water in the hair, an interdisciplinary subject with Biology. It presented the basic physical structure of the threads: Cuticles, Cortex and medulla, and the chemical composition of each one of them. The Protein, which makes up the largest mass of the thread, is present in the cortex, has the function of maintaining the structure, as if it were the basis of strength of the threads. Proteins are formed by combinations of amino acids, the main ones being: Keratin, Elastin and Collagen.

After approaching the structure of the strands, the resident explained the differences and the reasons why there are curly hair and straight hair. To understand this difference, it is necessary to have a base of knowledge in chemical bonds, normally addressed in the second year of high school, according to the



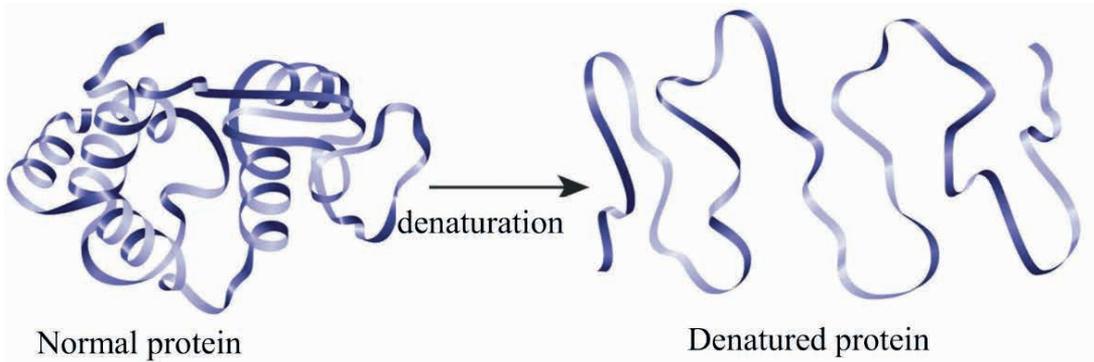
**Picture 1**– Structure of the hair strand.

Source: YANG, et. al., 2014.



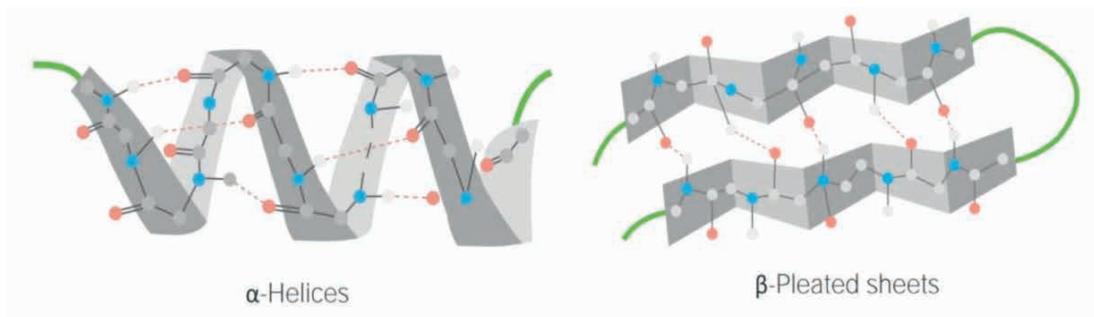
**Image 2**– Structure of a surfactant

Source: <https://www.infoescola.com/quimica/compostos-tensoativos/>.



**Image 3**– Effect of heat on proteins

Source: <https://md.cneceduca.com.br/102/biologia-identidade-funcional-da-vida>.



**Picture 4**– Change of capillary keratin.

Source: Lecturio.com.

BNCC.

The shape of the thread is determined from its birth, in the phase called Keratinization, which occurs in the hair bulb. The capillary bulb has different inclinations, which are responsible for determining whether the hair will be born smooth or curly, depending on the inclination, the keratinization will have more intimate connections, which will form a wavy structure, and following the growth of the hair will be even more attenuated by the interactions of hydrogen bonds present in a-Keratin. The first class, therefore, was the introduction to the concepts of structure and needs of hair, which gave the students a theoretical basis, and demonstrated why there is a variety of hair structures, also seeking the question and social function of hair.

### **SHAMPOOS X CONDITIONERS: WHAT ARE THEIR EFFECTS ON HAIR.**

Following the planning, after the theoretical basis presented, the next concepts addressed were: the action of Shampoos and Conditioners, the different types of straightening and their consequences for the capillary structure. Regarding Shampoos, it is a product used daily by everyone, however, it is not seen as "Chemical", the concept of chemical-free products was annulled and recognized as products that can harm the threads and products that can take care of them.

Shampoos are composed of SURFACTANTS, which are organic substances capable of reducing surface tension, since they can interact in a POLAR and APOLAR environment, their structure is called amphiphilic, as can be seen in the image:

After cleaning, due to the dissociation of the lauryl, the hair is negatively charged, which causes a tangled appearance, making it difficult

to comb, that is why CONDITIONERS are used, they cause a reverse effect on the charge of the hair, for be positively charged, which neutralizes the charge of the threads, giving them a malleable and soft texture. After the contents of the shampoos, the straightening part begins, talking first about the most used, THERMAL.

### **STRAIGHTENING: THERMAL AND CHEMICAL**

Thermal straightening is a way to temporarily alter the capillary structure, it is one of the most used straightening methods, firstly because it is not permanent, and also because it is more accessible in economic terms. Flat irons, or flat irons, are the most fundamental tools for thermal straightening, through temperature, they are capable of denaturing the a-keratin, temporarily breaking the connections that give it its elliptical structure, thus leaving the strands straight, but which only with the use of water, for example, reverse the transformation. According to an article published in ``Revista Braziliense``, on studies carried out at USP (``Universidade de São Paulo``), they demonstrate that from 250°C the damage caused to any type of yarn is irreversible, however, for the Afro-ethnic yarn (Crespo), demonstrates less resistance to temperature than the other Types.

Continuing class 2, in order to build a knowledge base for the capillary schedule workshop, chemical straightening was presented to the students. It is important to emphasize that no straightening is natural, since the thermal one is a sequence of chemical reactions that alter the physical shape of the threads, and all of them have consequences.

Chemical straightening is more sought after due to the power it has to transform a-keratin, which has an elliptical shape, into b-keratin, a sheet-stacking format, leaving hair straight. the hair grows, it will be in the

original format, with the need for touch-ups at the root.

This change is caused by the chemical products used, the beginning is the reduction of keratin, with the use of a basic means, in the area of straightening the most used are: ammonium thioglycolate and guanidine and a mercapnate or sulfide reducing agent, later Neutralization is carried out, which completes the reduction of the keratin, using an acid, thioglycolic acid, and an oxidizing agent, hydrogen peroxide. To finalize the chemical straightening, the wire is waterproofed, where it will keep the straightening longer. Formaldehyde is the most used in this step, and it avoids the reverse of keratin, from b-Keratin to a-Keratin.

### **HAIR SCHEDULE: PRACTICE**

To finalize the sequence of classes and the workshop, class 3 was a review of biological concepts, about proteins, lipids and water. Using the result of the questionnaire from class 1, so that at that moment the students could assemble their own capillary schedule.

The Capillary Schedule consists of an "Agenda" of hair care routine, being assembled according to the needs of the hair. It is divided into the stages of: HYDRATION, being the most basic and repetitive stage, because the water that helps in the metabolic functioning of the entire length of the thread. The NUTRITION stage, which will replace the lipids in the strands, these oils are essential for protecting the cuticles and adding shine to the hair. The last stage, which will be performed less frequently, is RECONSTRUCTION, which involves replacing the proteins in the threads, mainly Keratin, and tends to be performed when the threads are damaged, whether due to discoloration or straightening.

### **RESULTS AND DISCUSSION**

The entire sequence of Classes was

developed to prepare students for the Thematic Workshop, the Cup Test was a practice that linked all the concepts addressed. Through it, it was possible to analyze whether the students understood the basic structure of the threads, and their nutritional needs (Hydration, Nutrition or reconstruction).

The students put a strand of hair in a glass full of water, waited a few minutes and checked which part of the glass the hair was in. According to the test, if the hair strand remained on top, it means that it is "healthy", and only needs basic maintenance, which is HYDRATION. If the thread is in the middle of the glass, it shows that you have a lipid deficit, and NUTRITION will be necessary. The last situation is if the thread sinks, this would mean that its structure is damaged, the hair has lost mass and the cuticles are fragile, allowing water to enter the entire length, this causes the thread to sink in the water, and a RECONSTRUCTION (Proteins, mainly Keratin) to return to a healthy state.

After carrying out the test, discussing and sending the questionnaires, each student maintained their hair according to the result they obtained in their test, this part was carried out at home, and the results obtained were shared in a relaxed way in class.

### **FINAL CONSIDERATIONS**

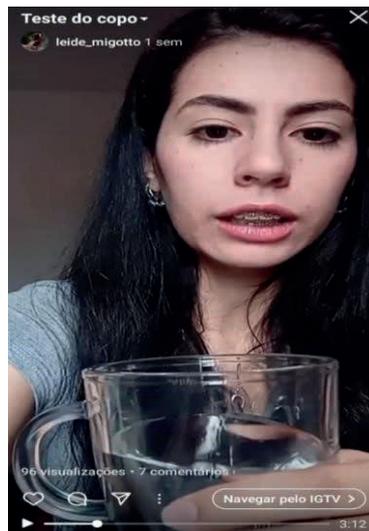
As a result of the Pedagogical Residency Program, the graduates of the Bachelor's Degree in Chemistry had the opportunity to experience reality in the classroom. Due to the Pandemic scenario, the experience was Virtual, and it demonstrated the difficulties in the Public Education network, however, it unveiled the opportunities, the Teaching Planning using a Hair Thread, demonstrates how a difficulty can mature ideas. Based on the results of the application of classes and student participation, I conclude that the use of the capillary theme as a teaching tool was

# CAPILLARY SCHEDULE

Monday	Wednesday	Friday
Hydration	Hydration	Nutrition
Hydration	Hydration	Reconstruction
Nutrition	Hydration	Hydration

**Picture 5**– Example of capillary schedule.

Source: Author's collection.



**Picture 6**– Video of the cup test in online class

Source: author's collection.

effective, and that such methodology can be applied in other fields of science teaching, as it captures students' attention, develops their critical and analytical sense.

### **ACKNOWLEDGMENTS:**

To God, my superior power.

To my advisor, Prof. Dr. Marcilene Cristina, for demanding from me the potential she always believed I had, for all the support and

attention and for always being there when I needed it.

To CAPES, for offering the Pedagogical Residency scholarship, an extremely important program for undergraduate students.

To my teaching institution, IFSP campus in São José dos Campos, and the entire teaching team, for the teachings and Lessons of each day.

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