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CHAPTER 12

Chemistry at the tip of brushes: Teaching chemistry through makeup for black skin

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ABSTRACT

According to an interview conducted by the cosmetics company AVON, about 46% of the 1000 black women interviewed have difficulties finding makeup for black skin tones. This research highlights the persistent difficulty faced by Black-skinned individuals in finding makeup products that suit their skin tone, leading many to resort to improvised solutions during the makeup process. In this context, the proposed work aims to explore the relevance of makeup for black skin as an educational tool in the teaching of chemistry. The planned activities aim not only to make students aware of the scarcity of foundation options available for the various shades of black skin, but also to connect this problem with the chemical principles underlying the formulation of cosmetics. In this way, students will be encouraged to reflect on how the science of chemistry can be applied to solve societal issues and promote inclusivity, while also deepening their understanding of fundamental chemical concepts. In addition to promoting self-knowledge about black identity, the approach to makeup for black skin as a tool in the teaching of chemistry seeks to bring students closer to the discipline in a playful way. This is done through an active methodology, which includes hands-on experimentation and a quiz on Google Forms to understand the difficulties students face when looking for makeup suitable for black skin tones.

Keywords: Makeup, Black skin, Didactic sequence and black identity.

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INTRODUCTION

The theme of this work was conceived with the intention of filling the lack of teaching that demonstrates to students the various applications of Chemistry, showing that science permeates their daily activities. In addition, it aims not only to train students, but also individuals capable of critically analyzing their social reality and, consequently, contributing to transform it.

In contemporary society, there is a growing interest among young people, especially among younger girls, in relation to makeup. This phenomenon reflects a significant cultural change, where the search for personal expression and self-esteem has led to a greater appreciation of beauty and care for one's appearance from an early age.

There is a lot of discussion around the difficulty in finding makeup products that cater to the diversity of black skin tones. When found, these products often come with high prices, making them unaffordable for many. As a result, many people have to resort to mixtures of different shades of makeup (one lighter and one darker) to achieve the desired shade for their skin. This reality highlights a gap in the makeup industry in terms of representation and accessibility, as well as highlighting the need for a change in this scenario to ensure that all skin tones are properly catered for.

In addition, many girls do not recognize themselves and the work brings this discussion and self-knowledge, since black identity is a complex journey, often influenced by a variety of social, cultural and historical factors. For many people of African descent, recognizing and affirming their racial identity can be a challenging process, especially in societies where structural racism is still prevalent. The lack of positive representation in the media and negative stereotypes associated with blackness can impact how black people see themselves and are seen by others. However, the strengthening of Black identity can be achieved through a journey of self-knowledge, education, and empowerment within the community, providing a safe space for reflection, dialogue, and celebration of the diversity and beauty of the Black experience.

Lead oxide contamination in makeup products is a growing public health concern, as lead is a heavy metal known to cause a range of adverse health effects, especially when absorbed by the human body. These lead oxides are often found in makeup pigments, such as lipsticks and eye shadows, and can pose a significant risk to consumers, especially those who use them daily. Long-term exposure to lead can lead to a range of health problems, including neurological damage, developmental problems in children, and reproductive complications.

With the objective of making young people aware of the importance of producing makeup suitable for black skin, this work proposes a didactic sequence that enables students to produce their own facial foundation. This becomes essential when they can't find suitable shades on store shelves. The proposal is to present Chemistry as an instrument to live better in society, in addition to

providing autonomy and knowledge so that they can create their own bases using easily accessible materials, thus ensuring that all skin tones are represented and adequately served.

OBJECTIVES

GENERAL OBJECTIVE

Create a didactic sequence with the theme "makeup for black skin" as a tool for teaching organic chemistry to students in the 2nd grade of high school.

SPECIFIC OBJECTIVES

- Propose interdisciplinary activities between the disciplines of Biology, Chemistry and History.
- Show the importance of black identity and its self-knowledge to the student.
- Relating racial factors to chemical science
- Propose a didactic sequence with a theme of the students' daily lives.

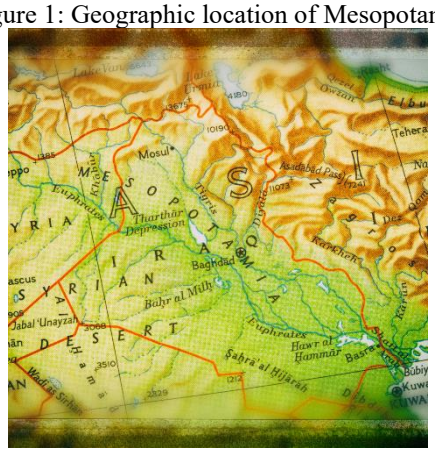
THEORETICAL FOUNDATION

HISTORICAL CONTEXT

The word makeup came from the word "Maquiler" or "makeup" which has the meaning of painting your own face or even beautifying yourself. (Medes, S.) (Bigio, V., 2016)

As much as the concept of makeup has been implemented in more recent times, there is evidence of the use of makeup since the Neolithic period, but its objective was to differentiate the peoples of a certain group. Such as, for example, the leaders of these groups were identified with animal teeth and sorcerers were identified through body paintings. The concept of makeup was only implemented as something related to beauty from ancient history in Mesopotamia, which was located in what we now call Iraq. During this period, body painting was carried out by men and women and made with saffron, red earth, kohl (charcoal) which was used as a base. However, there was a mixture containing lead in the composition, which was widely toxic. (Ramos, S.; Araújo, J; Silva, Ana P., 2022)

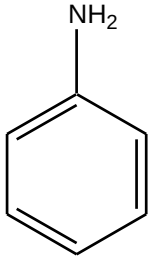
Figure 1: Geographic location of Mesopotamia



Source: (the author)

Throughout history, makeup has undergone several transformations. Initially, users believed that it had antibacterial properties due to the presence of lead, even though it was toxic. The Greeks and Romans improved the makeup of the Egyptians by introducing colors to the eyes and blending the khol, rather than marking it. The rose-cheek culture, popularized by the Romans with the use of red wine, was replaced by a liquid made from wine and red aniline (Figure 2). In the eighteenth century, cochineal began to be used as a rouge, and face powder was made from bismuth nitrate, white as lime. (Galembeck, F.; Csordas, Y.)

Figure 2: Aniline



Source: the author

Over time, the compositions of cosmetic products began to change due to harmful chemicals such as lead and the unpleasant odor of bismuth. The evolution of chemistry has driven the progress of makeup, the result of the constant accumulation of information and knowledge by society. The use of makeup has become an everyday practice among people, and this trend has endured to the modern day. (Santos, V., 2018)

Currently, there is a wide market of cosmetics available to consumers, covering products of different levels of quality, from the simplest to the highest-end. It is important to note that the difference in the quality of the products is related to factors such as elaborate, colorful, resistant and eye-catching packaging, which have the power to influence the consumer's choice, manipulating their imagination during the purchase process. (Santos, V., 2018).

FORMULATION OF THE BASES

Facial foundations are products that aim to cover and/or disguise skin imperfections, for this to occur, the foundation must be in the same skin tone so that it is very homogeneous. This product may have water, oil and silicone as its main ingredients, and may vary from product to product based on its purpose. (Oliveira, L., 2015)

Cosmetic bases produced based on oil contain emollients (which aim to soften and prevent skin dryness, which are vegetable oils and butters. An example is almond oil, which has oleic acid in its composition (Figure 3 - A), which is a fatty acid and, therefore, an organic acid with an open and long carbon chain, which has the carboxyl functional group (Figure 3 - B) at its end. In this type of foundation, there is also the presence of sunscreens, which are responsible for protecting the skin from ultraviolet rays from the sun, such as benzophenone (Figure 4 - A) that absorbs UVA rays and sulisobenzone (Figure 4 - B) that absorbs UVA and UVB rays. In both structures, there is the presence of a carbonyl that prevents ultraviolet rays from penetrating the skin. (Baki, G., 2015) (Costa, B., 2020)

Figure 3:
A: oleic acid B: carboxyl functional group

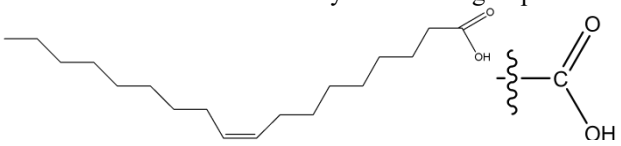


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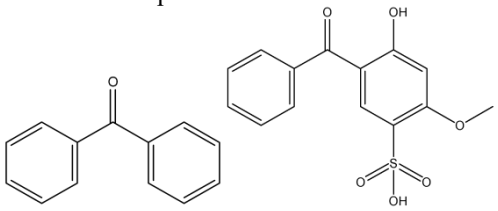
Figure 4:
A: benzophenone B: sulisobenzone



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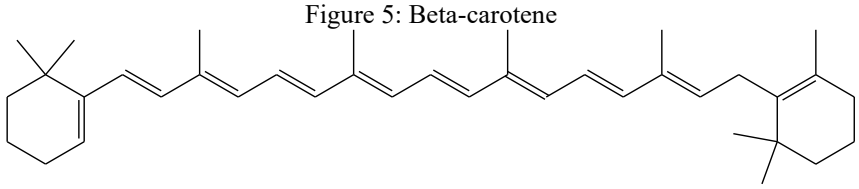
It is worth mentioning the presence of antioxidants whose main objective is to prevent the oxidation of oil-based components from occurring. According to P. Atkins: "the transfer of electrons from one species to another is now recognized as the essential step of oxidation, so chemists define oxidation as the loss of electrons, disregarding the species to which the electrons migrate." (Equation 1). An example of an antioxidant is beta-carotene (Figure 5), which has a protective action against the negative effects of sunlight exposure. (Atkins. P., 2018)

Equation 1: Oxidation example

$$O_2^- + 2H^+ \rightarrow H_2O_2 + O_2$$

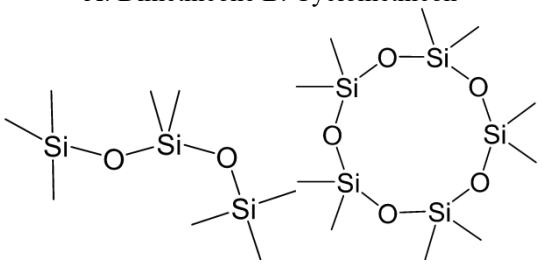
Figure 5: Beta-carotene



Source: the author

Oil-free bases, on the other hand, are formed by silicones, such as dimethicone (Figure 6 - A), also present in the composition of some sunscreens, or cyclomethicone (Figure 6 - B), which are polymers - macromolecules made up of smaller parts that are called monomers, and these monomers are repeated. These polymers are synthetic and basically composed of an organic structural portion and an inorganic portion composed of silicon and oxygen. (Baki, G., 2015).

Figure 6:
A: Dimethicone B: Cyclomethicon



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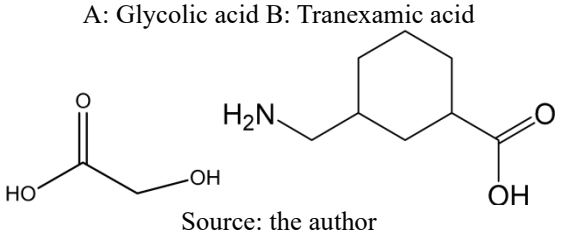
What gives the bases their proper color are opaque inorganic pigments, such as iron oxides (yellow, red and black), ultramarine oxides (blue) and chromium hydrate/chromium oxide (green), which are widely used. To improve dispersion and stability, treated or coated pigments can be used, such as silicone coating, which provides better glide and facilitates dispersion. This coating eliminates the need to grind pigments, which is commonly required for uncoated pigments. Titanium dioxide and zinc oxide are also used, but not for color, but as covering agents due to their white color. (Baki, G., 2015) (Costa, B. 2020)

Emulsifying components are substances that help stabilize the two immiscible parts in an emulsion, that is, the oily part and the aqueous part, preventing their separation. These agents have a hydrophobic part, which interacts with nonpolar substances, such as oil and silicone, and a hydrophilic part, which interacts with water. (Costa, B. 2020)

Nowadays there are already makeup bases that reduce spots from sunlight, and this type of product is responsible for a finish with a matte effect that controls the oiliness of the skin. These bases have nano glycolic acid in their formulation with glycolic acid nanoparticles (Figure 7 - A), tranexamic acid (Figure 7 - B) and sunscreen in their formulation, which has the effect of making the

skin smoother, well treated. In addition, it has an action that synthesizes melanin, which results in the reduction of skin blemishes. According to an article produced on the website Universidade estadual Paulista – UNESP- Nanoparticles are tiny objects whose dimensions vary from 1 to 100 nanometers (nm), and 1 nanometer is equivalent to 0.000000001 meters, or $^{10-9}$ meters in scientific notation. To give you a comparative idea, the average size of a nanoparticle is 15 nm, which means that they are approximately one million times smaller than a shirt button that is 1 centimeter in diameter. (O Boticário, 2023) (Magdalena, A., 2021)

Figure 7:
A: Glycolic acid B: Tranexamic acid

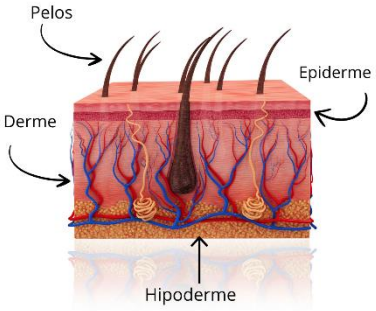


Source: the author

THE HUMAN SKIN

The skin is the largest organ in the human body, accounting for about 16% of body weight. Its main function is to protect internal structures from the external environment. The skin is composed of three layers: the epidermis, the dermis, and the hypodermis (or subcutaneous mesh). (Bernardo, Ana F., 2019)

Figure 8: Representation of the skin layers



Source: Canva

The epidermis is the outermost layer of the skin and has no blood vessels. Its thickness varies from 75 to 150µm micrometers, being thicker on the palms of the hands and on the soles of the feet, where it can reach 0.4 to 0.6 mm in thickness. The main function of the epidermis is to protect against external agents. (Bernardo, Ana F., 2019)

The epidermis is made up of several layers of flattened epithelial cells, arranged in a sequence from the inside out. These layers include the germ or basal layer, the spinous layer, the granular layer,

the lucid layer and the layer. These conventions work together to provide protection and regulation of water loss through the skin. (Bernardo, Ana F., 2019)

Skin color has a wide variety of shades and requires specific care according to age. All skin colors have melanin (Figure 9), but differences arise in the way melanin is distributed within the skin. This difference in melanin distribution results in variations in skin tones, as well as in the characteristics of the skin's response to sun exposure. While these topics are covered in more detail in the chapter on sun protection, here we will discuss the only difference between skin color and response to skin care products. (Bernardo, Ana F., 2019) (Alchorne, Mauricio., 2008)

Figure 9: Melanin

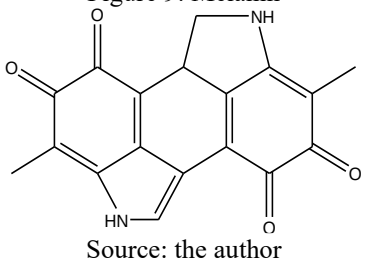


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Figure 10: Different skin tones

Source: Canva

CHEMICAL AND BIOCHEMICAL ASPECTS OF BLACK SKIN

The proportion of melanin in the outer layer of the skin, known as the epidermis, is higher in people of African descent, with notable discrepancies compared to fair-skinned individuals. This disparity is not related to the number of melanocytes, cells responsible for the production of melanin. Instead, it is explained by variations in the number, size, and arrangement of melanosomes, structures present in both melanocytes and keratinocytes. (Alchorne, Muricio. 2008)

In dark skin, melanosomes are larger and do not aggregate, but are distributed throughout all layers of the epidermis, especially in the basal layer. In contrast, in fair skin, melanosomes are smaller and tend to cluster together, predominating in the basal and malpighian layers and absent in the upper layers of the epidermis. (Alchorne, Muricio. 2008)

This discrepancy in the amount and distribution of melanosomes results in a natural variation in sun protection factor (SPF) between dark and light skin. Dark skin, due to its higher concentration of melanin, offers a natural SPF of around 13.4, with the Malpighian layer playing the main role in

filtering ultraviolet radiation. On the other hand, in fair skin, the natural SPF is lower, and the layer is the main responsible for this filtering. Although the stratum corneum in dark skin contains more layers of cells than in light skin, the overall thickness of the epidermis is similar in both cases. The difference lies in the compaction of melanosomes and their distribution in the various layers of the skin. (Alchorne, Muricio. 2008)

It's crucial to remember that these characteristics are just a few of the many natural differences between skin types, and that everyone, regardless of their ethnicity or skin tone, should adequately protect themselves against the sun's UV rays to prevent skin damage. (Alchorne, Muricio. 2008)

The genetic determination of skin pigmentation is not yet completely understood. Skin color is influenced by a specific combination of genes, resulting in a wide range of shades ranging from very dark to very light, with several variations in between. However, there is no clear global consensus on the definition of "dark skin" or "light skin," and these terms can have distinct meanings in different countries and cultures. (Alchorne, Muricio. 2008)

To try to establish a standardized classification of skin color, dermatology uses systems such as Fitzpatrick's (it is a numerical classification scheme for human skin color), which categorizes different phototypes based on the skin's response to sun exposure. Initially designed for fair skin, this system has been adapted to include darker skin, dividing it into phototypes IV, V and VI, which are less likely to burn and tan easily. (Alchorne, Muricio. 2008)

However, it is important to emphasize that these classification systems are not intended to define ethnicity, but rather to understand how the skin reacts to sunlight, whether through burns or tanning. It would be relevant to develop a classification system that is more suitable for darker skin, based on the propensity of pigmented skin to develop hyperpigmentation in response to inflammatory stimuli and to sustain this hyperpigmentation for a prolonged period, a characteristic unique to pigmented skin. (Alchorne, Muricio. 2008)

BLACK FEMINISM IN SCIENCE TEACHING

Between the 1960s and 1980s, feminism saw its growth on a global scale, and within this period, black feminists began a literary and intellectual production, generating the movement known as black feminism. In the Brazilian context, this movement had its beginnings in the 1980s, with the formation of the first black women's collectives. It is relevant to highlight that black feminism is not restricted to a struggle of identity only, but rather seeks to materialize democratic projects. (Jesus, Cristiane. 2018)

The interconnectedness between feminism and racial issues is crucial for a more complete and inclusive approach to women's experiences, ensuring that Black women's voices and perspectives are

heard and considered in the quest for equity, justice, and social transformation. Therefore, black feminism represents a significant and necessary contribution to the construction of a more egalitarian and diverse society. (Jesus, Cristiane. 2018)

At a certain point, black women were faced with the pressure to choose between engaging in the black movement or in the feminist movement in general. However, it is crucial to understand the intersections and connections between these two movements. Recognizing the diverse ways in which race, gender, sexuality, and class intertwine is essential. (Jesus, Cristiane. 2018)

Therefore, it is essential to address these issues intersectionally, recognizing how different systems of oppression intertwine and reinforce each other. Only by considering all these dimensions and their interrelations will it be possible to create a more inclusive and comprehensive struggle, which understands the complexity of black women's experiences and seeks more effective solutions for the construction of a more just and egalitarian society for all. (Jesus, Cristiane. 2018)

Despite the changes that have occurred in recent years in relation to the racial issue in Brazil, driven by social movements, there is still a long way to go for Brazilian society to understand that the struggles against racism and gender inequality must be addressed jointly, and not only by the people directly affected by these inequalities. Black women face double oppression, suffering from racism and sexism simultaneously. Therefore, the fight against these forms of discrimination must be a cause embraced by all, aiming at a closer approach to social equality. (Jesus, Cristiane. 2018)

To achieve a more just and equal society, it is crucial that people from all walks of life are involved in the fight against racism and gender inequality. Awareness and mutual support are key to combating discriminatory structures that affect the lives of Black women and other marginalized people. Only through solidarity and unity is it possible to move towards a society where everyone has their rights respected and equal opportunities. (Jesus, Cristiane. 2018).

BLACK SKIN MAKEUP AS A MOTIVATING THEME FOR CHEMISTRY TEACHING

Many black people report the difficulties they face when trying to find makeup that is suitable for their skin tone. From our own experiences as black women, we know that it is quite common to get grayish skin when using foundation and powder, even after several attempts at combinations with different shades and brands. This happens because the products available on the market are often not suitable for our skin tone.

The standard of beauty established by the white European colonizers created aesthetic icons that are part of a symbolic system of representation. In this context, black people were never considered beautiful. Beauty in our society, shaped under the influence of European colonialism, is associated with whiteness. Unfortunately, most of the cosmetics industry does not develop beauty products that adequately meet the needs of black people, especially those with darker skin. This leads

to a market segmentation that has a negative impact on a portion of the population that has always been made invisible. The limited supply of products for black skin becomes even more evident when it comes to face foundations or tinted sunscreens. While some brands feature a wide range of colors and shades, there is little diversity to cater to darker black skin.

In Brazil, a country that was the last to abolish slavery of black people in the Americas, the black population has historically faced poverty and a lack of purchasing power. This has caused the cosmetics industry to long ignore black audiences as consumers. Brazilians with black skin needed to adapt to the existing possibilities, resorting to mixtures between different products to find, hopefully, a suitable shade for their skin.

Only in recent years, with a portion of the black population having access to better living conditions due to more inclusive public policies, the industry has begun to perceive blackness as a makeup-consuming public. However, even with this expansion, many black people still have difficulties finding makeup suitable for their skin. This problem can be explored from the perspective of teaching chemistry, through awareness of its importance for the development of the appropriate foundation for each skin tone. With this, it is possible to learn chemistry through this theme.

THE INFLUENCE OF PAULO FREIRE ON THE TEACHING OF SCIENCE

The teaching of Science, as presented, reflects the influence of the positivist conception, which inspired the traditional approach to education, considering knowledge as something to be transmitted to students. The positivist perspective of science sees reality as something objective and immutable, where facts are given, and it is up to human beings to adapt to the world to know it through experiences. (Chapani, Daisi, 2013)

Under the intense influences of the empiricist-inductivist approach, the teaching of Science tends to neglect the socio-historical aspects of the production of knowledge, treating scientific content not as results of human activity, but as truths to be transmitted passively. Even in the face of criticism, this approach persists in school environments, perpetuating a curriculum centered on passive learning. (Chapani, Daisi, 2013)

Paulo Freire highlighted the limitations of the Traditional Conception of education, influenced by positivism, which, according to him, domesticated students through a methodology that emphasized the simple deposit of content and information, in an uncritical and decontextualized way. Considering that the first years of schooling play a crucial role in preparing children to interact with the world around them, we argue that the teaching of Science at this stage should provide opportunities for students to build knowledge through reflection and critical analysis of scientific content. (Chapani, Daisi, 2013)

The teaching of Sciences, based on the problematizing conception, recognizes the historical and changeable nature of scientific knowledge, considering it as an instrument to facilitate the process of humanization and hominization of individuals. In this approach, knowledge is not an exclusive property of the teacher, but rather something to be shared in an interactive and dialogical way with the class. Both the teacher and the students play the role of critical investigators in the classroom. (Ibraim, Stefannie)

It is important to highlight that the learning of Science content does not occur passively. According to Freire (1981), from a critical perspective, students are challenged by the text in its entirety, seeking to appropriate its deep meaning. Freire (1987) stresses the importance of problematizing knowledge during classes, using questions, doubts and challenges so that students develop a progressive understanding of the world. (Ibraim, Stefannie,)

In problem-based education, the central concept of criticality, as explained by Freire (1996), represents the transition from mechanistic thinking to an inquisitive attitude, an inclination to unveil something, expressed by verbalized or non-verbalized questions, seeking clarification. Criticizing the teaching of Science, according to this approach, implies breaking with the empirical-inductive model, transforming classes into moments of active construction and not just passive reproduction of scientific knowledge. (Ibraim, Stefannie,)

Freire points out that epistemological curiosity plays a fundamental role in the development of criticality in teaching. Teachers should stimulate this curiosity in the classroom, challenging students to seek knowledge continuously, promoting an environment conducive to questioning and the active construction of knowledge. (Auler, Decio. 2007)

There are several initiatives underway at different levels of education to make the teaching of Science more critical, adopting premises of Freire's theory. One of these movements is that of science, technology and society (STS), which has shown promise, including for the first years of schooling. It is crucial that students can actively engage in scientific practice, tackling authentic problems in which inquiry is an essential condition for resolution (Auler, Decio. 2007)

The STS focus focuses on the development of students' critical and argumentative capacity, addressing issues related to everyday life. In this teaching model, the presentation of scientific knowledge in the classroom aims to raise awareness, training for citizenship and, above all, the transformation of social reality. Dialogic interactions are fundamental in this teaching process, promoting constant exchange between teacher and student. (Auler, Decio. 2007)

EXPERIMENTATION IN TERMS OF ACTIVE METHODOLOGY

Science teaching needs an innovative pedagogical approach that is able to deal with the complexity of the teaching and learning process, going beyond the mere memorization of

information. The conventional approach used in science teaching does not stimulate students' critical thinking skills, nor does it prepare them to face the real challenges of society. For this reason, it is essential to explore and understand a variety of teaching methodologies and strategies. (Segura, Eduardo. 2015)

Within this context, active methodologies are recognized as effective principles in the teaching and learning process. These methodologies are based on deep reflection, integration and re-elaboration of new practices, in an autonomous and participatory way, placing the student as a protagonist in the development of knowledge. In this type of approach, students are directly involved in all stages of the process, demonstrating in practice what they have learned through creative productions that show their evolution and progress. The role of the teacher is to evaluate and provide feedback, closely monitoring both individual and collective progress of students. (Alencar, Carlos E. 2018)

The scientific method and its experimental phases can be incorporated as a practical approach to complement the theoretical instruction of a content or discipline, following the principles of active methodology. Its classical structure of problematization, hypothesis formulation, experimentation, and analysis of results make it particularly suitable to be used as a central component of teaching by active methodologies such as project-based learning. (Alencar, Carlos E. 2018)

Experimentation provides an opportunity to teach chemistry in a contextualized and relevant way, both in primary and secondary education and in higher education, allowing students to understand chemical phenomena in the context of the classroom. However, in order for teachers to be able to adopt this methodological strategy, it is essential that their training enables them to reflect on their pedagogical practice and to intervene in the educational reality as necessary. (Junior, João B. 2023)

METHODOLOGY

PART 1: DATA COLLECTION

Initially, a questionnaire was prepared using the Google form, intended for application to students in the 1st, 2nd and 3rd years of high school at the Fernando Rodrigues Silveira Application Institute – CAP UERJ. The students were given a period of one week to complete the questionnaire to think calmly about the answers.

The questionnaire consisted of a total of 11 questions, of which 2 were aimed at identifying the participants and 9 of the questions directly addressed the theme addressed in this work. A large part of this questionnaire was chosen objectively so that the questions were standardized, however, 3 discursive questions were chosen for the participants to demonstrate their opinions in relation to the theme of the questionnaire.

DIDACTIC SEQUENCE

Lesson 1: Introduction to the topic (2 times of 50 minutes each)

Description of the activity

In the first 30 minutes of class, a brief presentation will be addressed about the historical context regarding the evolution of makeup, so that in this class it is an interdisciplinary class with the history teacher, so that he can better present the context in which each era was. Example: Neolithic period, Mesopotamia and ancient Egypt.

In the next 15 minutes, the class will be divided into groups of 5 students and then they should draw a period of the story for students at home to research what makeup was like in that period, what it was used for and its composition, this work should be delivered printed in the next class.

Lesson 2: Introduction to the Chemistry of Makeup (2 times of 50 minutes each)

Description of the activity

In the first 50 minutes, there will be a presentation of the basic concepts of organic and inorganic chemistry relevant to the understanding of makeup chemistry, also addressing the theme of heavy metal contamination.

In the next 50 minutes, there will be a discussion about the different types of makeup products and their main ingredients and the presence of heavy metals in their composition, addressing the main consequences of using products that contain heavy metals.

Lesson 3: Skin issues (2 times of 50 minutes each)

Description of the activity

Interdisciplinary class with the biology teacher , addressing the biological part of the skin, such as showing how the skin is divided and what gives the pigmentation of human skin. Lasting 50 minutes.

In the next 50 minutes , melanin and its formula will be addressed, and it will be possible to identify organic functions and other concepts related to organic chemistry such as sigma and pis bonds present in its structure.

Lesson 4: Difference between makeup for black skin and white skin (2 times of 50 minutes each)

Description of the activity

In this class, there should be a debate with the class about the number of makeup for black skin and white skin based on the question "Why is the quantity of foundations for white skin greater

than the quantity of makeup for black skin? Regarding facial foundations for black skin, do you know how many brands have the various colors for black skin?"

From this discussion, the teacher should address the chemical issue of these facial bases so that the reason for the lack of this diversity on store shelves is justified, this activity should be delivered in printed form to the teacher in the next class

Then, students must be divided into groups of 5 people, who will take each ingredient to make the homemade recipe for the production of the base that will be carried out in the next class.

The ingredients needed are: plastic tube, cotton swab, cornstarch, cocoa powder, facial moisturizer and glycerin. It is worth mentioning that the glycerin must be taken by the teacher and all ingredients must be purchased in health food stores.

Lesson 5: Experimental class – production of a face foundation (2 times of 50 minutes each)

Description of the activity

In the first 20 minutes, the experiment script will be given to the students along with a color palette so that each student can identify their skin tone, which will be numbered from 1 to 7.

Students should produce the foundation for the next 30 minutes and should be aware that the cocoa that is used to give the pigmentation of the foundation should be added gradually, since it is to each skin tone.

In the next 20 minutes, students must answer a brief questionnaire individually that must be delivered on the same day. The questionnaire will be carried out on the chemistry present in the products used for production. And in the next 30 minutes, students must write a report on the practice showing the chemical aspects of the practice, identifying the role of starch and cocoa in the production of the handmade facial base.

Lecture 6: Lecture

Description of the activity

Lecture given by a professional from a cosmetics company in which the production process of a base in the industry will be addressed and then the theme of heavy metals present in makeup will be addressed

DISCUSSION

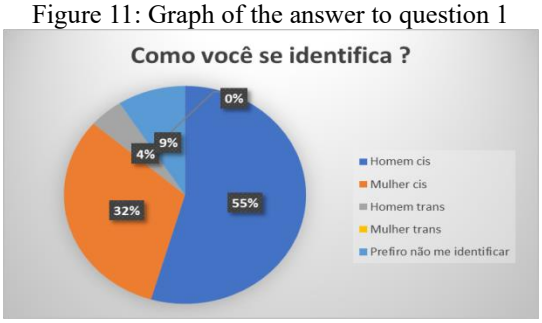
PART 1: DATA COLLECTION

The questionnaire was set up on Google Forms and applied to two classes of 1, 2 and 3 years of high school at the Fernando Rodrigues Silveira Application Institute – CAP UERJ. However, the answers of the students of class 1B were chosen for data treatment, the answers of the students

achieved the objective in question, which was to talk about black skin and the teaching of chemistry, the class is composed of 26 students, and of the class, only 22 answered the questionnaire.

The first question was about identification, with the objective of getting to know the class. Of the 22 students who answered the questionnaire, 55% identify with the gender cis man, 32% identify with the gender cis woman, 4% trans man and 9% preferred not to identify themselves.

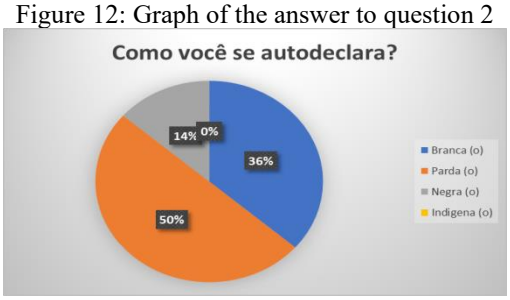
Figure 11: Graph of the answer to question 1



Source: the author.

Only 14% of the class identifies as black, indicating that blacks are still a minority in basic education, even in public schools. However, there is a significant number of students who declare themselves brown compared to whites. This is due to the fact that some students do not identify as white or have a defined black identity.

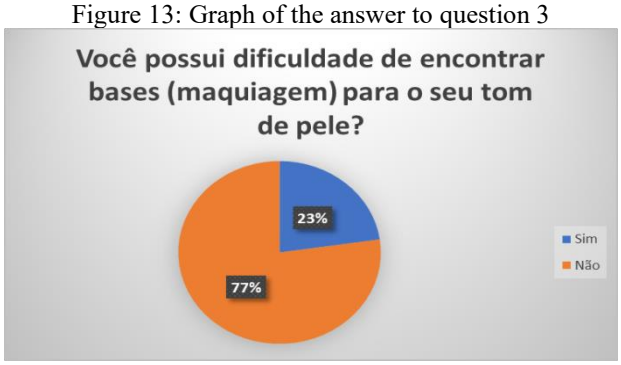
Figure 12: Graph of the answer to question 2



Source: the author

The next question delves deeper into the topic, showing that 23% of respondents report difficulties in finding makeup bases that match their skin tone. This data reveals an inequality in product availability, as 77% of respondents do not face this problem, suggesting that markets offer a greater variety of foundations for lighter skin tones. Thus, the survey shows that there is a predominance of options for fair skin on the shelves, while the various shades of black skin find less representativeness and availability of suitable products.

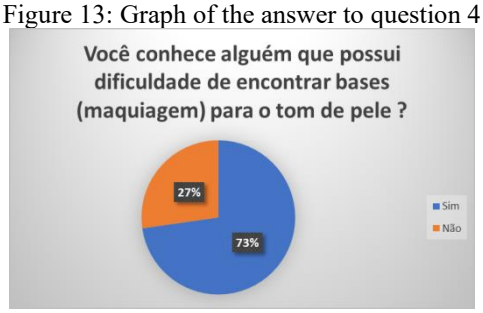
Figure 13: Graph of the answer to question 3



Source: the author

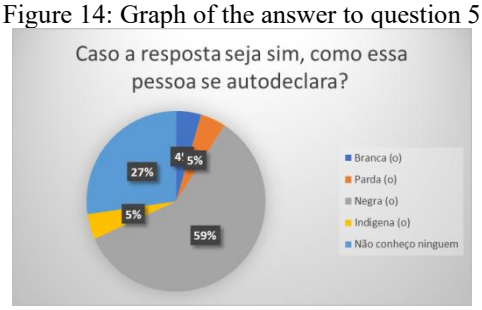
The survey shows that 73% of respondents know someone who faces difficulties in finding makeup bases suitable for their skin tone, and 59% of these people declare themselves black. This situation reflects the lack of options available in the market for darker skin tones. In response to this limitation, 27% of respondents resort to mixing foundations of lighter and darker shades to achieve the desired color. This improvised practice highlights the scarcity of specific products for black skin. In addition, the survey indicates that 73% of respondents prefer not to purchase the product when they do not find the ideal foundation for their skin tone, evidencing frustration and dissatisfaction with the limited supply of products on the market.

Figure 13: Graph of the answer to question 4



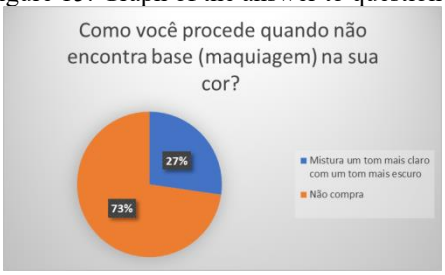
Source: the author

Figure 14: Graph of the answer to question 5



Source: the author

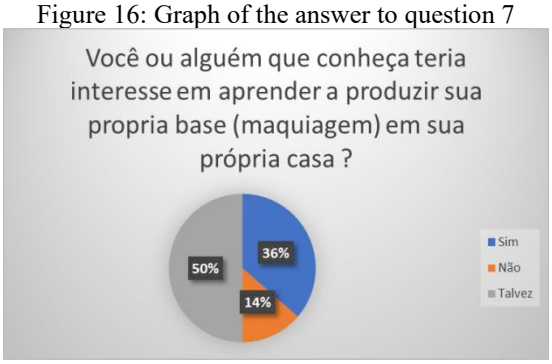
Figure 15: Graph of the answer to question 6



Source: the author

One possible solution to the shortage of suitable face foundations is the artisanal production of cosmetics, according to the research conducted. The data shows that 36% of respondents are interested in manufacturing their own bases, thus seeking products that better meet their specific needs. However, 14% of respondents are not interested in this alternative. This lack of interest can be explained by the fear that homemade products may cause skin irritations, lesions, or allergies, as well as concern about possible errors in the manufacturing process. Artisanal production requires precise knowledge of the right ingredients and methods, which can intimidate some consumers.

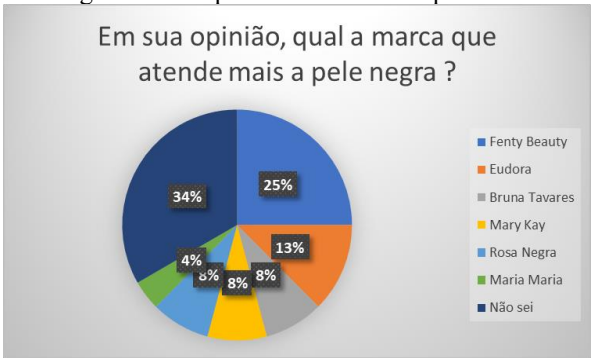
Figure 16: Graph of the answer to question 7



Source: the author

The last question of the survey aimed to identify which makeup brand best caters to the diversity of black skin tones. Among the six brands mentioned by the students, Fenty Beauty stood out as the most mentioned. This recognition is due to the fact that the brand was founded by a black woman, which results in greater care during the production of products and a more comprehensive inclusion of the various shades of black skin. However, about 34% of students answered that they do not know which brand best meets this demand. This shows that some students really do not have knowledge about makeup brands, while others are unaware of brands that promote this inclusion effectively. This data highlights the need for greater dissemination and awareness of the availability of inclusive makeup products in the market.

Figure 17: Graph of the answer to question 8



Source: the author

The last question of the questionnaire asked students to write their opinions about the great difficulty in finding makeup that met the diversity of black skin tones. One particularly striking response came from one student, who not only addressed the issue of diversity of skin tones, but also explored the intersection of gender and race. She highlighted how this difficulty in finding suitable products not only reflects the lack of representation in the beauty industry, but also reinforces stereotypes and social inequalities. Her in-depth analysis brought to light the importance of an inclusive and sensitive approach, which considers the specific needs of Black people and the influence of social constructs of gender and race on the availability and promotion of beauty products.

Figure 18: Last question and your questionnaire answer

Escreva o que você acha sobre a grande dificuldade em encontrar maquiagem para a diversidade de tons de pele negra *

Eu acho que isso ainda faz parte do racismo estrutural, há pessoas/marcas que não se esforçam em achar os melhores tons para as peles negras e com isso os/as negrxs tem muita dificuldade ainda em achar bases para seus tons... pois mesmo com o público falando que bases negras deixam a pele mais acizentada ou deixam mais claras a pele.

Source: the author

PART 2: DIDACTIC SEQUENCE

By the end of the first class, students are expected to gain an in-depth understanding of the evolution of makeup over the centuries. This includes knowing the different forms and styles of makeup used in various eras and cultures, understanding the materials and techniques employed in each historical period, and realizing how social, economic, and cultural contexts have influenced these transformations in the art of makeup.

By the end of the second lesson, students are expected to have a clear understanding of the fundamental chemical concepts that are involved in the formulation of makeup products. Additionally, they should be well-informed about the risks and issues associated with heavy metal

contamination such as lead, including the harmful health effects that these contaminants can cause and the importance of safe regulations and practices in the cosmetics industry to minimize such risks.

At the end of the third class, students are expected to understand in detail the biological concepts that involve the structure and functions of the skin. In addition, they must understand the chemistry of melanin, including how it is produced by melanocytes, the different types of melanin, and how these pigments influence skin color variation between people.

By the end of the fourth lesson, students are expected to understand in depth the issue of the lack of diversity in the foundation tones available for black skin. They should be able to identify how the limited supply of suitable products by a few brands negatively impacts Black-skinned consumers, highlighting the importance of inclusive and equitable representation in the cosmetics industry. Additionally, they are expected to discuss the social and economic implications of this lack of diversity and explore potential solutions to promote greater inclusivity in beauty products.

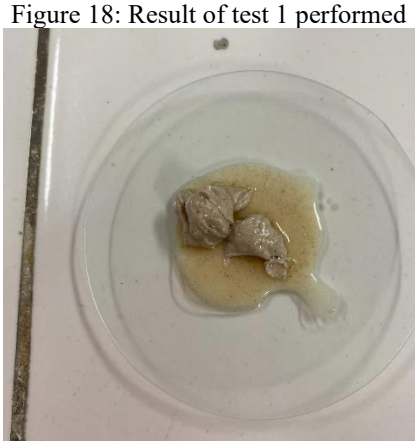
By the end of the fifth class, students are expected to acquire the ability to create their own facial base using easily accessible materials. During this practical activity, they must understand in detail the chemical concepts involved, such as the selection and function of each ingredient (such as cocoa, which aims to give the product the proper pigmentation, which is replacing the melanin molecule), the chemical reactions that occur during mixing, and the techniques to adjust the shade of the foundation for different skin types. In addition, students must learn the importance of component ratio and stability to ensure the quality and safety of the final product. At the end of the experimental practice, it is expected that students will answer the evaluative questionnaire very clearly and may have understood the chemical concepts addressed during the classes. The evaluative questionnaire and the response pattern are attached in the appendices. (Serbeto, Victoria. Chemistry at the Tip of the Brushes: Teaching Chemistry Through Makeup for Black Skin. 2024 UERJ)

PART 3: EXPERIMENTAL SCRIPT

To arrive at the final recipe, tests were carried out in the laboratory that were done in a few stages. Materials used were: Facial moisturizer, Corn starch, Cocoa powder, Turmeric, Glycerin.

In test 1, 4.83 g of moisturizer; 1.91 g of corn starch; 0.71 g of cocoa: 0.71 g; 1.00 mL of glycerin; Saffron was exempted in this test**.** It was observed that it did not present the color of black skin, since the amount of corn starch used was greater than the amount of cocoa that aims to give the proper pigmentation to the facial bases for black skin, with this, it is observed that this tone would be the ideal tone for lighter skin tones. It was also observed that due to the presence of glycerin, the base tended to be less viscous, that is, more liquid.

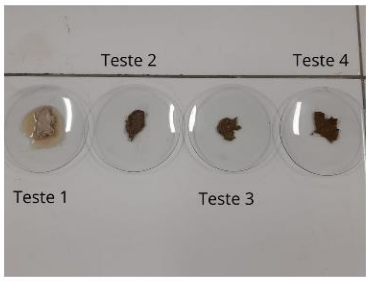
Figure 18: Result of test 1 performed



Source: the author

In test 2, 5.00 g of moisturizer, 0.36 g of corn starch, 0.43 g of cocoa and 0.40 mL of glycerin were used. In test 3, a 2.5 g sample from test 2 was used and 0.94 g of turmeric was added. In test 4, a 1.25 g sample of test 3 was used; 0.81 g of turmeric and 0.30 mL of glycerin. In test 5, 5.27 g of moisturizer was used; 0.36 g of corn starch; 0.36 g of cocoa and 0.80 mL of glycerin. In these tests, a pigmentation color was found, but it was observed that the cocoa beans were not uniform, when passed on the skin, it was possible to see the presence of starch grains on the skin.

Figure 20: Comparison of the results of tests 1 to 4 performed



Source: the author

In test 6, 6.55 g of moisturizer was used; 0.25 g of corn starch; 0.30 g of cocoa powder and 0.3 mL of glycerin. In test 7, 6.55 g of moisturizer was used; 0.15 g of cornstarch; 0.15 g of cocoa and 0.2 mL of glycerin. In tests 6 and 7, even decreasing the amounts of cocoa and starch, the presence of irregular cocoa beans was still observed, so it was necessary to macerate the cocoa so that the cocoa pigmentation in the moisturizer occurs more uniformly. In these last tests, saffron was removed from the formulation since it had a very strong odor of spice, thus decharacterizing a homemade cosmetic. As a result, there was a need to carry out another test, which was bought again: cocoa, which did not need to macerate, since the beans were more uniform. With this, the color

palette was created so that students during the practical class could check what their skin tone would be.

Figure 21: Color palette

Source: the author

FINAL CONSIDERATIONS

The purpose of this study was to develop a didactic sequence composed of practical and accessible activities, designed to be applied in schools that do not have advanced technological resources or specialized laboratories. The proposal aims to ensure that the quality of teaching is maintained, even in contexts with structural limitations. For the effective implementation of these activities, it is crucial that teachers, in partnership with the pedagogical team, dedicate themselves to adapting and applying teaching strategies in a collaborative and integrated manner, thus ensuring the best educational performance by students.

The proposal of didactic sequence seeks to enrich the educational experience by combining the knowledge of Biology, Chemistry and History, promoting an interdisciplinary approach that stimulates student participation and makes the learning process more engaging. It is crucial to emphasize that this sequence is intended to be implemented after the conclusion of the study on organic functions, taking advantage of the concepts and content already covered to deepen students' understanding and promote an integrated view of the disciplines.

In addition, the flexibility of the proposal allows the activities to be adapted according to the needs and time available in the classroom, enabling a better adaptation to the students' learning pace and the demands of the curriculum. This adjustable approach provides greater autonomy to the teacher, allowing him to make modifications according to the context and specific objectives of each class, without compromising the quality of teaching.

The approach to makeup for black skin seeks to involve students in a more meaningful way in the discipline, by connecting an everyday issue - the scarcity of cosmetic products adapted for this type of skin - with concepts of chemistry. This connection between a social theme and chemistry

provides students with a broader and more contextualized understanding, stimulating their reflection on how science is present in relevant issues in society.

REFERENCES

1. Ramos, A. (2022). *O poder além da beleza: Uma proposta didática para o ensino de Química a partir da temática maquiagem*. Editora Científica Digital. Disponível em: www.editoracientifica.org.

2. Medes, S. (2023). Apostila de maquiagem página 3. Disponível em: https://designvisualuff.wordpress.com/. Acesso em: 21 de abril de 2023.

3. Bigio, V. (2023). Maquiagem ou Maquilagem. Disponível em: https://www5.pucsp.br/maturidades/curiosidades/curiosidades_ed69.html. Acesso em: 21 de abril de 2023.

4. Galembeck, F., & Csordas, Y. (n.d.). *Cosmético: A química da beleza*.

5. Santos, V. (2018). *A importância do uso da maquiagem para os contornos faciais*. Maquiagem: A história (57 páginas). FASIPE, Mato Grosso.

6. Souza, D., & Machado, K. (2019). Maquiagem do Século XXI. *Cosmetics Online*, 31. Disponível em: https://www.cosmeticsonline.com.br/.

7. Baki, G., & Alexander, K. (n.d.). *Introduction to cosmetic formulation and technology*.

8. Desconhecido, A. (2023). Hidratantes, umectantes e emolientes. Qual a diferença? Disponível em: https://pharmaceuticajr.com.br/blog/hidratantes-umectantes-e-emolientes-qual-a-diferenca/#:~:text=Os%20%C3%B3leos%20vegetais%20e%20manteigas,agem%20na%20restaura%C3%A7%C3%A3o%20da%20pele. Acesso em: 24 de abril de 2023.

9. Atkins, P., Jones, L., & Laverman, L. (2018). *Princípios de química: Questionando a vida moderna e o meio ambiente* (7ª ed.). Porto Alegre: Bookman.

10. Costa, B. (2020). *Estudo de maquiagem facial com ação camufladora e antioxidante* (37 páginas). Universidade de São Paulo.

11. Desconhecido, A. (2023). Qual a diferença entre Dimeticona e Simeticona? Disponível em: https://www.cff.org.br/pagina.php?id=569&titulo=Dimeticona+e+Simeticona. Acesso em: 24 de abril de 2023.

12. O Boticário. (2023). Saiba tudo sobre a base Make B. Glycolic TX. Disponível em: https://www.boticario.com.br/dicas-de-beleza/saiba-tudo-sobre-a-base-make-b-glycolic-tx/. Acesso em: 30 de maio de 2023.

13. Desconhecido, A. (2023). Como funciona os protetores solares. Disponível em: http://www.petquimica.ufc.br/como-funcionam-os-protetores-solares/. Acesso em: 5 de maio de 2023.

14. Davolos, M. R., Flor, J., & Correia, M. A. (2007). Protetores solares. *Química Nova*, 30(1), 153-158.

15. Draelos, Z., & Thaman, L. (n.d.). *Cosmetic formulation of skin care products*. Taylor & Francis Group.

16. Debin, E. (2019). Filme, experiência e tecnologia no ensino de ciências químicas: Uma sequência didática. *Revista de Educação, Ciências e Matemática*, 9(1), 1-15.

17. Araujo, D. (2013). O que é (como faz) sequência didática? *Entrepalavras*, 3(1), 322-334.

18. Bernardo, A. F. (2019). Pele: Alterações anatômicas e fisiológicas do nascimento à maturidade. *Revista Saúde em Foco*, 11.

19. Sena, R. (n.d.). Sequência didática para o ensino de metodologia científica em curso técnico de administração integrado ao nível médio.

20. Giordan, M. (1999). O papel da experimentação no ensino de ciências. *Química Nova na Escola*, 10. Disponível em: https://www.qnesc.sbq.org.br.

21. Pessoa, A. C. (n.d.). Sequência didática. Disponível em: https://www.ceale.fae.ufmg.br/glossarioceale/verbetes/sequencia-didatica. Acesso em: 14 de fevereiro de 2024.

22. Alchorne, M. (2008). Dermatologia na pele negra. *Educação Médica Continuada*.

23. Canavarro, A. (2018). Cultura africana e afro-brasileira e o ensino de química: Estudos sobre desigualdade de raça e gênero e a produção científica. *Educação em Revista*.

24. Jesus, C. (2018). Roda de conversa em espaços não formais: A química do cabelo e do empoderamento negro no ensino de química. *Revista da ABPN*, fevereiro.

25. Gomes, C. (2019). Consumo e identidade: O cabelo afro como símbolo de resistência. *Revista ABPN*, fevereiro.

26. Serbeto, V. (2024). *Química na ponta dos pincéis: Ensinando química através da maquiagem para pele negra*. UERJ.