

SUIANE COSTA ALVES

ENVIRONMENTAL EDUCATION AND INTERDISCIPLINARITY

PEDAGOGICAL PROPOSAL FOR
LABORATORY PRACTICES IN THE
CHEMISTRY CURRICULAR
COMPONENT



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LETTER FROM THE AUTHORS

Dear colleagues,

It is with great joy that we launch the book *Environmental Education and Interdisciplinary: pedagogical proposal for laboratory practices in the chemistry curricular component*. This edition was designed to encourage students in the universe of scientific initiation, developing the inventive spirit, intellectual autonomy, student protagonism, motivating reflection-action that impacts local and global communities.

Thus, the book begins with reflections on the importance of interdisciplinarity, as well as the methodological assumption of teaching through investigation that guided this work. The structural part of each pedagogical proposal begins with the didactic approach, followed by the competencies and skills of the National Common Curricular Base (BNCC, 2018), an approach to environmental education content aligned with laboratory practice, objectives, materials and methods, as well as complementary activity.

Each chapter seeks to motivate the understanding of chemical principles based on technological development, using modern research and its applications in order to motivate constructions that can positively impact society. In this way, the proposed activities seek to develop the student's ability to solve problems, encouraging creativity and *Maker Culture* in order to lead them to think about probable answers.

We thus wish to contribute to strengthening scientific literacy, providing new ways of doing Science, enhancing the learning experience, following the chemical descriptions and constructions promoted in all its interfaces. We appreciate the support we received, as well as the suggestions from readers that will help refine this work and make it more interesting and useful. We hope that you will find in this book the necessary support for the development of good pedagogical practices in the chemistry curricular component.

Sincerely,

Suyane Costa Alves

2. INTRODUCTION

The new secondary education brings with it numerous challenges, as its objective is to prepare young people to continue their studies and enter the world of work, it seeks to promote education respecting the potential and personal conditions of each student. As Natural Sciences are an agent of social change, they are capable of helping students improve their knowledge, providing their intellectual development, understanding concepts and methodological procedures associated with attitudes and values (BNCC, 2018). Therefore, reflecting on the challenges and perspectives of Chemistry Teaching has become a growing need in the search for contextualization of programmatic curricula.

In this context, we are invited to think about the interdisciplinary process of the Natural Sciences Curriculum. Interdisciplinarity has become an expanding theme given its enormous importance in the face of education in a globalized world and, in this process, working on IoC aims to promote the strengthening of the teaching and learning process, as they converge in all their fluidity to the desired interdisciplinarity that according to Fazenda (2007) apud Lima and Alves *et. al.* (2016), consists of the exchange of concepts, theories and methods between different disciplines in order to revolutionize the current school structure. Thus, interdisciplinarity and the Internationalization of the Curriculum (IoC) make it possible to expand the potential for interaction between the student and the object of knowledge where, according to Knight (2020) apud Alves, Rosa and Neto *et. al.* (2021), internationalization presents different analytical frameworks whose objective is to understand the central concepts related to the process of internationalization of the curriculum, as well as to discuss this process, which is multi-stratified, assisting in the student's teaching and learning process.

Since chemistry is a modern science and given the needs that arise in today's society, many young people are led to the question: why study chemistry? How to apply chemical knowledge in everyday actions? Chemistry is a science capable of interfering in the development of society, which is an agent of social change, configuring itself as a set of ideas capable of helping students improve their knowledge. In addition to assisting in the intellectual development of high school students, it promotes the search for understanding nature and its transformation, through the production of experiments (BNCC, 2018).

The relationship between competencies and skills in the National Common Curricular Base (BNCC) is guided by four structuring axes: 1) Scientific research; 2) Creative processes; 3) Sociocultural intervention; 4) Entrepreneurship. Among the BNCC (2018) competencies most directly linked to laboratory practices we have the understanding of natural and social reality based on acquired knowledge, contributing to solidarity and justice, as well as investigating and formulating hypotheses, with scientific and technological criteria, to formulate and resolve issues.

Thus, this pedagogical proposal for Laboratory Practices in the Chemistry curricular component dialogues with the scientific initiation and creative processes axis, where students are invited to reflect on the problems that arise in contemporary society, promoting Maker Culture and entrepreneurship. Thus, the object of this pedagogical proposal comes from the chemistry curricular component more directly linked to environmental issues aiming at the sustainability of natural resources, bringing a study-by-investigation approach, presenting discussions about the fundamental aspects of environmental chemistry. To place this process in the context of the internationalization of the curriculum, Knight (2020) talks about terms such as globalization, regionalization and, currently, planetization, seeking to elucidate the benefits of internationalization in the academic and intercultural field, transforming and impacting curricula, promoting reflection in students. about the difficulties that present themselves in today's society. Thus, working on emerging themes related to sustainability expands the possibilities of IoC.

The national and international scientific community that works in the field of Environmental Chemistry plays an important role in the development of research that seeks to elucidate the chemical processes that aim to guarantee the preservation of natural resources. With the help of experimental study, chemical science becomes capable of answering questions that arise before and after investigation. In this sense, the didactic approach to teaching through investigation allows the development of skills related to scientific initiation and problem solving, structuring the research stages, searching for evidence, raising hypotheses, drawing up conclusions and reporting the results found.

For Ausubel, Novak and Han Esian (1980), meaningful learning is seen as a continuous and active process of knowledge. In this dialogue, Zompero and Laburú (2010) established some relationships between investigative activities in teaching linked to Ausubel's theory of Meaningful Learning. The arguments presented are: (1) the

existence of a problem to be investigated; (2) the issuance of hypotheses by students; (3) the perception of evidence; (4) student engagement. Thus, in dialogue with the IoC, this process is immersed in cognitive and intercultural aspects in the promotion of skills and abilities inherent to the training process, assuming an increasingly prominent role due to the fact that it can contribute to the formation of the subject facing the global reality, understanding its surroundings and acting as a transformative agent for society as proposed by the Center for International Studies in Education (CEIE).

Educational transformations on a global scale have accelerated the challenges of promoting education with equity, guiding young people to project themselves in the world. And in this process, different sectors of life interrelate, such as politics, economics, social relations, communication, work and the environment, being linked to the object of study of internationalization on a local and global scale. Therefore, this book presents the pedagogical proposal for laboratory practices, divided into chapters and sessions, designed to assist in the teaching and learning process of students attending high school. The first chapter deals with the didactic and methodological assumptions of teaching chemistry through investigation. The second chapter deals with paper recycling, followed by the third chapter, which discusses the practice of recycling waste oil. The fourth chapter talks about recycling toxic waste, the fifth chapter deals with plastic recycling and the sixth chapter deals with the study of the hole in the ozone layer. The seventh chapter discusses the use of petroleum in the production of manufactured articles and its consequent environmental problems, the eighth chapter talks about the reuse of tire dust (vulcanization process), and, finally, the ninth and final chapter deals with the production of essential oils.

In this way, the vision expressed in the National Common Curricular Base (BNCC) is referenced, according to which the curricular component of Natural Sciences that make up the area of study most directly linked to environmental issues, combined with sustainable development, are capable of producing knowledge in a dynamic interrelationship of scientific and dynamic concepts, including the entire cultural universe of chemical science, thus dialoguing with Morosini (2018) who, from the IoC perspective, states that every discipline must be developed by integrating international themes, motivating reflections in students, enabling the development of skills to act in contemporary reality. In this way, concepts and content are associated with human-social training, addressing real situations that facilitate the learning process.

3. DIDACTIC AND METHODOLOGICAL ASSUMPTIONS

When discussing the process of Internationalization of the Curriculum from the perspective of Natural Sciences Teaching (*Internationalization of the Curriculum in the Nature Sciences*), constitutes a challenge, as it invites us to think of knowledge as a production that has a local and global impact. Thus, when Leask responds to the question “*what is internationalization*”, the author (2015) defends the internationalization of the curriculum as fundamental for strengthening global education that seeks to prioritize respect and unity between different cultures, breaking paradigms that still exist today between nations, where internationalization acts as a strategic action, promoting the dimensions of teaching and research, as well as the provision of services by universities, as seen below,

Internationalization can facilitate an inclusive, intercultural dimension to the teaching, research, and service dimensions of a contemporary university including its commercial and entrepreneurial pursuits. (LEASK, 2015).

For Leask (2015), the Internationalization of the Curriculum (IoC) does not seek to promote homogenization, nor westernization with its consequent maintenance and reinforcement of privileges of dominant groups and languages. Expressly, IoC is about to be used as a stimulus to question dominant paradigms, says the author. Supported by the process of internationalization of the curriculum, there are emerging professions worldwide, which seek qualified professionals to meet global demands, resolve ethical issues in relation to global problems, promoting dialogue between nations, thus making use of critical pedagogy to outline new Pathways to 21st century education.

In this context, Teaching Chemistry based on laboratory practices as an active methodology helps in the link that must be made between the knowledge shared in the classroom and the students' daily lives. The references brought by the National Common Curricular Base (2018) seek to organize the learning of the Natural Sciences curricular component in high school in order to produce effective knowledge, with its own meaning. This area available at BNCC proposes the thematic organization of the Natural Sciences curricular component (Biology, Physics and Chemistry) incorporating concepts and practices to be worked on in an interdisciplinary way, aligned with Geology and Astronomy.

Among the thematic units prescribed by BNCC (2018) in the Natural Sciences curricular component, we have the *Matter and Energy unit* that brings together the disciplinary and conceptual fields with regard to the properties of matter, the process of generation and use of energy, as well as energy matrices. The unity of *Earth and Universe* is more interconnected with the biological and cosmological constitution, climate processes and environmental sustainability. The *Scientific-Technological* unit is equipped to face problems, as well as to use scientific language. Therefore, by restricting chemistry to formal classroom learning, the teacher runs the risk of not providing the student with the opportunity to develop projects that could be applied in the daily life of their community. Therefore, one of the objectives of the Science Educational Laboratory (LEC) is to help contextualize formal classroom knowledge, providing useful learning for life and work, as information, skills, abilities and the values developed become real instruments of perception.

According to Dourado (2001), experimental activities are essential for the teaching-learning process and must be adapted to the skills and attitudes that are intended to be developed in students. The aforementioned author mentions that the inclusion of laboratory activities in Science Teaching began at the beginning of the 19th century, when science disciplines began to be part of the curricula of many countries. However, teachers, in general, even knowing the motivating, playful role and essentially linked to the meanings that involve the interdisciplinary articulation of this knowledge, among which technological and practical content stands out, speak of the difficulties encountered in using such resources .

The advantage of interdisciplinarity and IoC is the interaction between the various disciplines, forming partnerships, valuing the dialogue between educator and students, ensuring a pleasurable, playful and thought-provoking education. The proposal for teaching through investigation and the CTSA approach (Science – Technology – Society – Environment) has the potential to provide students with the opportunity to understand the chemical, biological and physical phenomena most directly linked to their daily life, as the objective most frequently associated with STS teaching refers to the development of decision-making capacity, which is related to solving real problems involving social, economic, technological and political aspects, preparing the individual to actively participate in democratic society (Santos and Schnetzler, 1996) . Thus, working on laboratory practices within school units aims to articulate the reality of the classroom

with the student's daily life, seeking innovation and the use of the LEC , bringing low-cost experiences that guarantee the effective and systematic use of the laboratory.

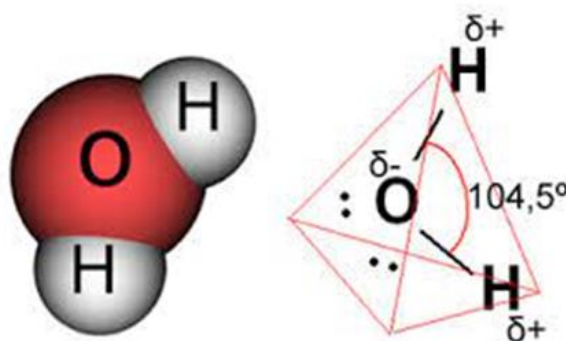
Theoretical classes in subjects in the area of natural sciences occupy a large part of the course load and practical classes are scheduled according to the availability of factors such as physical space and available materials. Due to the technological apparatus and easy access to information, it is possible to produce science in the classroom through interdisciplinary actions, with the teacher being responsible for encouraging the student to produce new knowledge, as scientific reflection promotes the resignification of knowledge and, in the face of In addition, the possibility of doing science. According to Dr. Eloneid Felipe Nobre, professor of the Physics II subject of the Master's in Teaching in Science and Mathematics, “ awakening the student's attention and interest is the great task that science teachers have ahead of them. ” Another important reflection on the school curriculum consists of promoting diverse didactic-pedagogical methodologies to be worked on based on the needs of the student and the school community. Regarding Chemistry Teaching, this document establishes that:

The study of Chemistry, from this perspective, involves the participation of young people and adults in processes of investigating problems and phenomena present in their daily lives. By investigating issues related, for example, to garbage, the pollution of urban rivers and lakes, and the air quality of their city, students will have the opportunity to develop their knowledge, formulating answers that involve social, economic, political aspects, among others. others, thus exercising their citizenship. It is important that this training makes it possible to understand how Chemistry was consolidating itself as a science, with its methods, models and theories. This allows understanding the dynamics of knowledge generation, with its advances, disputes and errors, and the influence of social contexts in this process of human construction. It is necessary to guarantee school space and time to address these topics, so that knowledge makes sense for students' lives (BRASIL, 2018, p. 147).

For Santos (2006), the use of experimentation to contextualize content must involve student leadership, motivating the inventive spirit and intellectual autonomy. The development of skills and abilities on the part of the student is a continuous process that must take place throughout their school life and, Therefore , the BNCC (2018) explains a set of skills to be developed by the student throughout their school life. In this context, Chemistry Teaching through investigation must emphasize didactic proposals in which the content transcends the limits of the disciplines towards everyday life, meaning student learning.

4 PHYSICAL-CHEMICAL ANALYSIS OF WATER

Water is a molecular compound made up of hydrogen (H) and oxygen (O) that is extremely important for the lives of all living beings that inhabit planet Earth, as without it there would be no life. Its composition presents intermolecular forces such as hydrogen bonds (or Hydrogen Bonds) with an angular arrangement (104.5°). Thus, the bond formed between oxygen and hydrogen in the formation of water (H_2O) is 1:2. This combination is due to the fact that oxygen has 6 electrons in the last layer (Chalcogen Family) and hydrogen has 1 electron in the last layer (Alkaline Metal Family).



<https://brasilecola.uol.com.br/quimica/relacao-entre-polaridade-solubilidade-das-substancias.htm>

The large increase in demands for water caused by the growth of the world population and the activities carried out by it are factors that lead to the lack of this vital resource. This is due not only to supply problems, but also to intensive use and losses in different parts of the system, from water treatment plants to the point of consumption. Countries around the world suffer from the lack of this asset, which is also precious for the survival of living beings. Water is considered a universal solvent, where all reactions of living organisms occur in an aqueous medium. Another characteristic present in the water molecule is the formation of surface tension, which consists of a very thin film formed on its surface.

Faced with such reflections, there is a need to think about ways to solve this global problem that has affected human survival.

a) Didactic approach

Through the process of physical-chemical analysis and using Maker Culture to promote creativity, it is possible to create instruments that can have a social impact, improving people's quality of life. Thus, the school's mission is characterized by characterizing itself as a space of diversity, construction and socialization of knowledge, highlighting its importance for the production and dissemination of scientific literacy, constituting itself as an agent of social change. Through the interdisciplinary work of chemistry with other disciplines from the different curricular components, it is possible to enable a better understanding of the contents, focusing on meaningful learning (Lima and Alves, 2016). Based on these reflections, it becomes increasingly necessary to create methods for the treatment of water in order to make it potable, enabling greater accessibility for the low-income population, being the section of society most affected by the scarce lack of vital resources.

Management and monitoring work must be based on the dissemination and monitoring of social activities that aim to meet the needs of the population in all its dimensions. In this regard, working with water without a potability index (water from artesian wells) becomes a tool capable of solving or, at least, mitigating the impacts of water shortages. According to Schmidt (2011), diseases resulting from the ingestion of pathogens in contaminated water have a major impact on global health, where around 80% of all diseases and more than a third of deaths in developing countries are caused by the consumption of contaminated water. .

b) Chemistry content: Characteristics of the Water Molecule (H₂O)

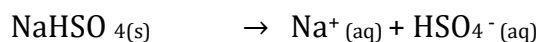
As previously stated, water has the molecular formula H₂O, being a molecular compound formed by covalent bonds. The hydrogen potential (pH) of drinking water is slightly acidic, with a value around pH=6. pH control is essential for the survival of living organisms because small variations in pH can cause changes in the formation of enzymes, as well as alter their functionality. In this way, the discussions covered in the chemistry curricular component become instructional in nature, highlighting the importance of the topic studied. Within the topic studied, in addition to controlling the pH of the water, the titration process technique assists in the qualitative analysis of samples, also allowing the identification of ions by measuring conductivity.

In this process it is possible to identify: 1) Stoichiometric relationship and concentration of the solution; 2) Relationship between pH and biochemical reaction in living organisms; 3) In the titration process it is possible to identify the impurity levels present in the sample; 4) Relationship between chemical balance and the presence of organisms in the water, such as *total coliforms* and *Escherichia coli*.

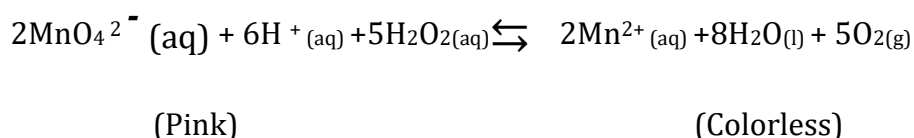
The titration process involves the addition of a solution, called a titrant, called an analyte, placed in a buret. To carry out the physical-chemical analysis of the water (Atkins and Jones, 2012), the *Standard Methods for the Examination of Water and Wastewater* method was used. Initially, pH will be measured using the bromothymol blue indicator (C₂₇H₂₈BrO₅S) and a pH meter for greater accuracy of the results. Afterwards, the conductivity and temperature will be measured.

We will use the described technique to identify the impurity present in water samples by identifying the pH of the samples. For impurity analysis, students will be asked to prepare a solution of potassium permanganate (KMnO₄) using a volumetric flask. To do this, 10 ml of the KMnO₄ solution will be sucked and then distilled water will be added up to the 100 ml mark. Soon after, 50 ml of the water sample will be poured into each Erlenmeyer flask and 1 tablespoon of Sodium Hydrogen Sulfate (NaHSO₄.H₂O) will be added to each one. The titration will be carried out by dripping slowly until the solution presents a distinct pink color, as can be seen in the reactions:

Sodium Hydrogensulfate (NaHSO₄.H₂O) dissolved in the water sample to be analyzed, the physical process of dissociation occurs:



HSO₄²⁻(aq) is able to protonate water through a Bronsted-Lowry acid-base mechanism. Then, the sample that will be titrated with a KMnO₄ solution, discoloration of the solution should be observed when the sample has large amounts of organic impurities.



The analyzes must comply with Ordinance No. 2914 of December 12, 2011 of the Ministry of Health, which regulates the potability of water samples.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . In the *Matter and Energy* units, it brings together disciplinary fields with conceptual and practical intent regarding the property of matter in different states. Analysis of biogeochemical cycles in natural phenomena and human interference with them. Recognize the most relevant aspects of human interaction with the environment. Produce mechanisms for water filtration in order to make it potable.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105/EM13CNT208

g) Environmental Education content

Reflections on the conscious use of water have been increasingly present in discussions in search of the sustainability of water resources. In this sense, reuse allows a greater volume of water to remain available for other purposes. Regarding wastewater, its use is a practice that has been growing, promoting rational and efficient use. According to Assano (2002) Schaer-Barbosa apud *et. al.* (2014), it is an internationally established practice and has been widely used, in a safe and controlled manner, in several countries, including to increase the supply of drinking water, as occurs in Namibia. Regarding the supply of water suitable for human consumption, the use of filters made from activated carbon from green coconuts has proven to be ecologically correct and economically viable, and can function as a preventive health program.

h) Objective

Understanding the environmental problems related to water and using laboratory practices and Maker Culture, create mechanisms that can help with this problem that affects the world's population.

i) Material and methods:

Materials: Samples of water to be analyzed, distilled water, Sodium Hydrogen Sulfate ($\text{NaHSO}_4 \cdot \text{H}_2\text{O}$), bromothymol blue indicator ($\text{C}_{27}\text{H}_{28}\text{BrO}_5\text{S}$), pH meter, thermometer, conductivity meter, potassium permanganate (KMnO_4), beaker, titration glassware (iron pedestal, buret and Erlenmeyer flask), beaker, glass rod.

Method: We will use the technique described to identify the impurity present in water samples by identifying the pH of the samples. For impurity analysis, students will be asked to prepare a solution of potassium permanganate (KMnO_4) using a volumetric flask. To do this, 10 ml of the KMnO_4 solution will be sucked and then distilled water will be added up to the 100 ml mark. Soon after, 50 ml of the water sample will be poured into each Erlenmeyer flask and 1 tablespoon of Sodium Hydrogen Sulfate ($\text{NaHSO}_4 \cdot \text{H}_2\text{O}$) will be added to each one. The titration will be carried out by dripping slowly until the solution has a distinct pink color. The samples will be titrated before and after passing through the filter using green coconut activated carbon.



Figure: Filter made from activated carbon from Coco verde
Source: Direct Search

The filter can be classified as environmentally friendly, as it encourages the recycling of green coconut fiber in the production of activated carbon and is economically viable, due to its low cost. The idea is to create a booklet that teaches the population how to maintain the filter, consolidated as a Preventive Health Program. Due to the fact that activated carbon from this fruit has chlorine adsorption properties (removing color, flavor and foreign odors from water and other chemical products), it is proposed to use this raw material to improve water quality. According to Schmidt (2011), filters produced

from activated carbon include water stabilization, since it has a porous structure and homogeneous density, making the water potable.

j) Scheduled activities

After studying the characteristics of the water molecule, titration process and qualitative analysis of the water, the creation of the filter using activated carbon from green coconuts. Thus, students will have the opportunity to exercise student leadership, intellectual autonomy and an investigative spirit.

k) Additional Questions

1. (ENEM) (Enem) According to a global organization of environmental studies, in 2025, two out of every three people will experience water shortages, if there are no changes in the current pattern of consumption of the product.

An appropriate and viable alternative to prevent shortages, considering global availability, would be:

- a) develop water reuse processes.
- b) explore underground water beds.
- c) expand the supply of water, capturing it from other rivers.
- d) capture rainwater.
- e) import fresh water from other states.

Answer: C

5 PAPER RECYCLING

In Brazil, tons of paper are produced every year to meet the increasingly growing demand of the consumer market. In this sense, it is essential that governments encourage the production and consumption of recycled paper by the population, contributing to the reduction of environmental impacts produced during this process.

Among the benefits brought by paper recycling, we can mention the reduction in water consumption during the manufacturing process, reduction in energy consumption, reduction in the deforestation process, as for each ton of recycled paper, an average of 15 to 20 trees.

In the paper recycling process, in addition to water consumption, there is a high consumption of binder and consumption of chlorine used to whiten the paper. The cellulose pulp produced from this process is pressed and then left to dry, depending on the type of use intended for the paper. Although this process is more expensive than the recycling process, there is still a large rejection of the use of recycled paper, which ends up making it expensive to manufacture due to low consumption. As public and private institutions begin to encourage the use of this product, the tendency is for the population to form the habit of consuming recycled paper, which will bring great benefits to the environment in the long term.

a) Didactic approach

Through the paper recycling process, there is the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching chemistry. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning from teaching this discipline. It is worth highlighting that reflection on the investigative nature of your teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation.

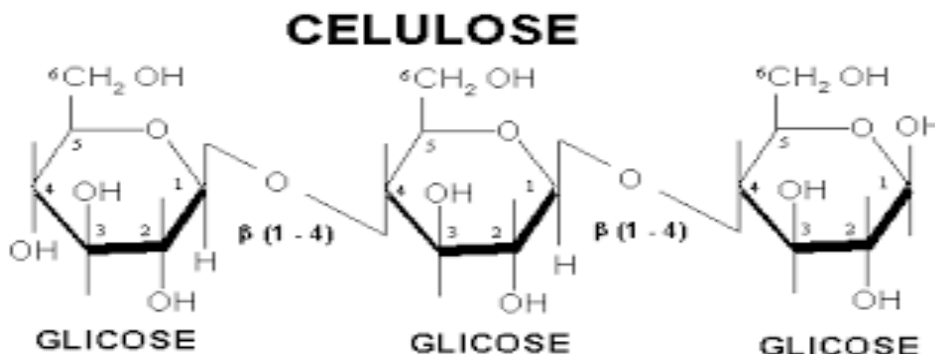
In the context of the importance of paper recycling, the student has the opportunity to observe the extensive consumption of water and binder, in addition to reflecting on the treatment of residual lignin produced during the process. In this investigative context, the student develops skills and abilities that will be used by them

throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) Chemistry content : Hydrocarbons / Oxygen Function / Organochlorines

Hydrocarbons are organic compounds formed basically by carbon and hydrogen and, due to the tetravalency of carbon, it is capable of forming long stable chains, as is the case with cellulose. This compound is a long-chain polymer formed by the union of glucose monomers. Cellulose is an important polysaccharide, a fundamental compound of the plant cell wall, present in large quantities in the structure of paper. Thus, cellulose is a heterogeneous chain cyclane that belongs to the oxygenated alcohol function, in which this cyclohexanol is basically formed by carbon, hydrogen and oxygen.

Figure 1 - Glucose Monomers



Source: <http://gracieteoliveira.pbworks.com/w/page/50091415/A%20c%C3%A9lula>

A problem that arises in the industrial manufacture of paper is the formation of the compound originating from the union between chlorine and residual lignin. Lignin is a three-dimensional polymer of aromatic nature and its structural base is phenylpropane, present in the plant structure. The union between residual lignin and chlorine in the paper bleaching process leads to the formation of organochlorine compounds that end up being stored in the wastewater used in industries specializing in this type of process. It is worth mentioning that the presence of this compound in large quantities in the body can lead to genetic changes.

Figure 2 – Organochlorine compounds

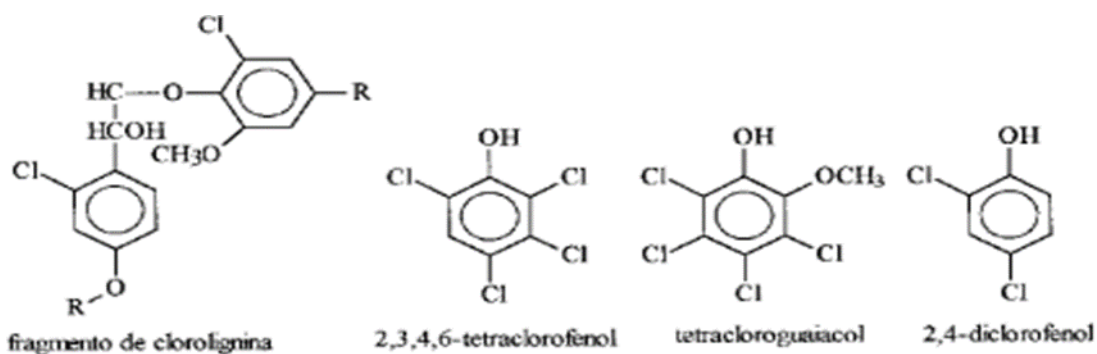


Figura 1. Exemplos de compostos organoclorados presentes nos efluentes das indústrias papeleiras.

Source: FREIRE et. al, 2000

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . In the *Matter and Energy* units, it brings together disciplinary fields with conceptual and practical intent regarding the property of matter in different states, as well as the generation and use of energy. Analysis of biogeochemical cycles in natural phenomena and human interference with them. Recognize the most relevant aspects of human interaction with the environment; Recognize the relationship between the organic compound cellulose, which belongs to the oxygenated alcohol function, and its presence in paper manufacturing; Observe how the chemical process of paper manufacturing takes place and how it can cause harm to the environment.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105

g) Environmental Education content

The indiscriminate production and disposal of paper has been one of the major environmental problems under discussion in recent years. This product, basically composed of cellulose, in addition to helping to increase waste production, has led to an increase in deforested areas and, consequently, the influence on global warming, pollution

of the waters that supply industries specialized in the manufacturing process of paper by organochlorine compound. Thus, one of the proposals to minimize the problems caused by the production and consumption of paper is by encouraging recycling practices within teaching units, as a way of encouraging ecologically correct practices, as well as favoring the reduction in the consumption of paper produced by the school unit, encourages the reduction of deforestation.

h) Objective

Understand the environmental problems that affect human quality of life, through the study of hydrocarbons with an oxygenated function, with the practice of paper recycling as a way of raising students' awareness about the use and consumption of paper.

i) Material and methods:

Materials: water, used paper, glue (binder), dye, blender, screens for paper molding. For every 100g of paper, you must use 50 ml of binder and 50 ml of water.

Method: collect the paper used at school and leave it to soak for 24 hours in water. Then combine the paper, water and binder in a blender until a uniform pasty mixture is formed. Take this material to the screen to be pressed and then dry in the sun and/or wind. The paper produced can be used in the school unit to make gift boxes, used in the printer to make cards, used by teachers in pedagogical planning, etc.

j) Scheduled activities

After studying the oxygenated functions and approaching the biochemical relationship of the cellulose structure as a glucose monomer, it is necessary to carry out laboratory practice as a way for the student to better understand the chemistry content through the practice of paper recycling. The student will have the opportunity to use the paper he made within school activities. One proposal is to make cards for Father's Day.

k) Additional Questions

1. (ENEM) Based on projections made by experts, an increase in the average temperature on the planet is expected to be between 1.4 °C and 5.8 °C by the end of the 21st century. As a consequence of this warming, The climate will possibly be hotter and wetter, as well as more flooding in some areas and chronic droughts in others. Warming will also cause the disappearance of some glaciers, which will lead to a rise in ocean levels and the flooding of certain coastal areas. The climate changes predicted for the end of the 21st century, thus:

- A) They will cause a reduction in evaporation and condensation rates in the water cycle.
- B) They may interfere with water cycle processes that involve changes in physical state.
- C) They will promote an increase in the availability of food for marine species.
- D) They will lead to an increase in water sources, which will solve the problems of lack of water on the planet.
- E) They will cause an increase in the volume of all water courses, which will minimize the effects of aquatic pollution.

Answer: B

2. (ENEM) The industrial production of cellulose and paper is associated with some environmental problems. One example is the characteristic odors of volatile sulfur compounds (mercaptans) that are formed during the removal of lignin from the main raw material for the industrial production of cellulose fibers that form paper: wood. It is in the bleaching stages that one of the main environmental problems caused by the cellulose industries is found. Reagents such as chlorine and sodium hypochlorite react with residual lignin, leading to the formation of organochlorine compounds. These compounds, present in industrial water, discharged in large quantities into rivers by paper industries, are not biodegradable and accumulate in plant and animal tissues, potentially leading to genetic changes.

To reduce environmental problems arising from paper manufacturing, it is recommended:

- A) the creation of more lenient legislation, in order to favor the manufacture of biodegradable paper.
- B) the reduction of reforestation areas, with the aim of reducing the volume of wood used to obtain cellulosic fibers.
- C) the distribution of deodorization equipment to the population living in the vicinity of paper production industries.
- D) the treatment of industrial water, before returning it to water courses, with the aim of promoting the degradation of soluble organic compounds.
- E) the collection, by families living in the surrounding regions, of solid waste generated by the paper industry, in a selective waste collection process.

Answer: D

3. (ENEM) With the intensive use of the computer as an office tool, a sharp decline in the use of paper for writing was predicted. However, this prediction was not confirmed, and paper consumption is still very high. Paper is produced from plant material and, as a result, huge extensions of forests have already been extinct, some being replaced by homogeneous reforestation of a single species (in Brazil, mainly eucalyptus).

To prevent new areas of native forests, especially tropical ones, from being destroyed to supply growing paper production, the following actions were proposed:

- I.** Increase paper recycling, through selective collection and processing in plants.
- II.** Reduce paper import tariffs.
- III.** Reduce taxes on products that use recycled paper.

For a healthier global environment, just:

- A) proposal I is appropriate.
- B) proposal II is appropriate.
- C) proposal III is appropriate.
- D) proposals I and II are appropriate.
- E) proposals I and III are appropriate.

Answer: E

6 RESIDUAL OIL RECYCLING

The term lipid originates from the Greek “*lipos*”, which means fat. Therefore, vegetable and animal oils and fats are of great importance, as they are part of the organic constitution of these beings. The waste oil recycling process is linked to the saponification process. According to historical reports, this process was already practiced by the Phoenicians before Christ, in which they heated animal fat with sodium carbonate or potassium carbonate.

With the development of medicine and the discovery of the microscope, there was a greater intensification of the use of soap in order to combat diseases caused by pathogenic microorganisms. Encouraging the recycling of waste oil is extremely important, as its disposal in the environment, without prior treatment, pollutes water resources, soil, among other natural spaces. It is worth mentioning that its direct disposal into the sewage system ends up causing serious damage to the water, which will be consumed after treatment, since the spilled oil is not completely removed, returning to the population's homes.

a) Didactic approach

Through the waste oil recycling process, there is the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching this discipline. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation.

In the context of the importance of recycling waste oil, the student has the opportunity to observe the extensive consumption of sodium hydroxide used in the saponification process, in addition to reflecting on the subject with the concept of acid and base, hydronionic potential (pH), use of indicators, among others. In this investigative context, the student develops skills and abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through

investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

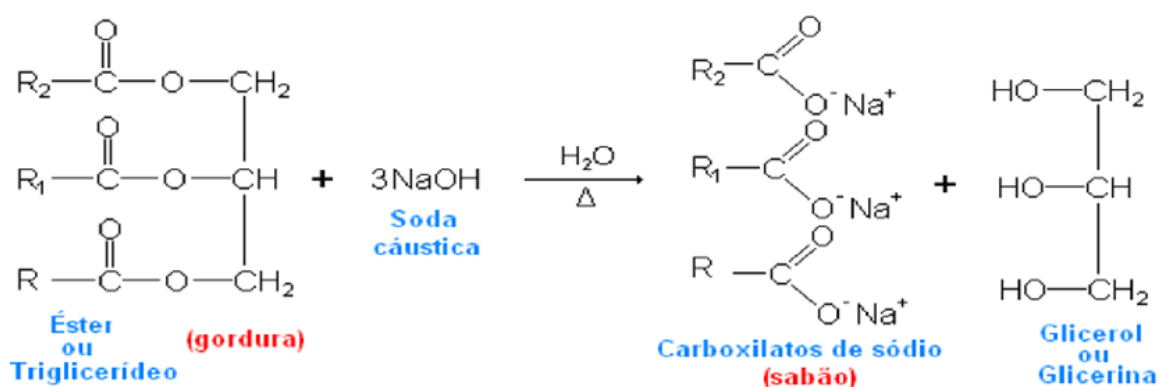
b) From the content of Chemistry : Natural Polymers

Natural polymers are macromolecules formed by the union of monomers, through the process called polymerization. The Chemistry content that deals with natural polymers includes an item on the study of fatty acids, responsible for the formation of oil and fat. Lipids are highly energetic and poorly soluble compounds, being the largest form of energy storage in the body. Adipose tissue helps protect the body's internal organs against shocks and injuries. Thus, lipids help in the absorption and transport of vitamins A, D and E, which are fat-soluble.

Food sources rich in lipids are oils, olive oil, butter, margarine, mayonnaise, among others. Cooking oil is a type of vegetable oil derived from unsaturated fatty acids, belonging to the oxygenated carboxylic acid function. Thus, the study of lipids, which is an ester, when reacting with water, forms a superior fatty acid and a monoalcohol. This substance, in addition to causing serious environmental problems, as it promotes water contamination when dumped into the plumbing system without treatment and when in excess in the human body, can cause an increase in cholesterol and triglyceride levels, which can lead to stroke.).

Therefore, one option for properly disposing of residual oil is to make soap. Soaps are fatty acid salts obtained from the reaction between a glyceride and a strong base, as can be seen in the following reaction:

Figure 3 - Saponification Reaction



Source: < <http://www.agracadaquimica.com.br/quimica/arealegal/outros/219.pdf> >

In this process, sodium hydroxide and potassium hydroxide can be used.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . In the *Matter and Energy* units, it brings together disciplinary fields with conceptual and practical intent regarding the property of matter in different states. The *Earth and Universe unit* brings together the processes of environmental devastation and the need for sustainability of natural resources. Describe the chemical transformations in the saponification process; Identify the damage caused by the indiscriminate disposal of oil into the environment.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT3109

g) Margarine production

To make margarine, from polyunsaturated vegetable oils (corn, sunflower, soybean, safflower oil) it is necessary to transform the liquid oil into a more stable form (emulsion or solid). The process used to “solidify” the oil is **hydrogenation** (heating (260°C) in the presence of hydrogen, using a metallic catalyst), where hydrogen atoms are added to the fat molecules so that they become more saturated, increasing their stability and consequently the its melting point, thus remaining the oil in solid form at room temperature.

In foods of plant origin, fatty acids are predominantly in the unsaturated form with “cis” isomerism, with trans isomers present in very small or practically non-existent quantities in vegetable oils and fats. During the hydrogenation process, in addition to the elimination of some double bonds through saturation, some of these double bonds can acquire the trans configuration and change position along the chain. Discussions about the cardiovascular harm of the trans form to health have been widely debated, forcing manufacturers to modify production processes, minimizing or eliminating the trans form of margarine (it is quite common to find margarine packaging highlighting “trans-free”).

h) Environmental Education content:

One of the biggest environmental problems we have today concerns the recycling of domestic waste oil. Even within teaching units, this material can be seen to be disposed of inappropriately, often ending up in the sewage system. It is worth mentioning that the oil present in the water, when it goes to the treatment plants, is difficult to remove because the treatment plants do not extract this material, which means that this product returns to homes through the water network. plumbed. Therefore, one of the ways to avoid inappropriate disposal of waste oil is by encouraging recycling.

i) Objectives

Recognizing the need to deepen the knowledge learned in the classroom, as well as providing opportunities for active reflection on everyday actions, the practice of recycling waste oil is proposed as a way of generating an ecologically correct product, through the production of soap.



Source: http://pt.slideshare.net/soradinda_59/reciclagem-de-leo-de-cozinha

j) Material and methods

Materials: hot water, sodium hydroxide, residual oil, plastic bucket, soap molds, essence (softener). For every 100 ml of filtered residual oil, 20 g of sodium hydroxide, 40 ml of hot water and 08 ml of fabric softener are used.

Method: collect the residual oil and filter it. 40 ml of water must be boiled and after heating add 20g of sodium hydroxide (caustic soda). Mix the water and sodium hydroxide solution with the residual oil and stir for 90 minutes. Transfer the homogeneous mixture to the molds and leave it to rest for a week.

k) Scheduled activities

The student will have the opportunity to make soap within the teaching unit using waste oil produced by the school unit.

l) Additional Questions

1. (ENEM) Half of the volume of cooking oil consumed annually in Brazil, around two billion liters, is incorrectly disposed of in drains, sinks and manholes. It is estimated that each liter of oil discarded pollutes thousands of liters of water. The oil in the sewer tends to create a barrier that prevents water from passing through, causing blockages and, consequently, flooding. Furthermore, by contaminating water sources, it results in fish deaths. The recycling of cooking oil, in addition to being necessary, has a market in the production of biodiesel. There is a current demand for 1.2 billion liters of biodiesel in Brazil. If there is planning in collection, transportation and production, it is estimated that up to R\$1.00 per liter of oil to be recycled can be paid.

Source: Program shows the way for the use of frying oil in the production of biodiesel. Available at: <<http://www.nutrinews.com.br>>. Accessed on: 14 Feb. 2009 (adapted).

According to the text, the inappropriate disposal of cooking oil causes several problems. In order to contribute to solving these problems, one must:

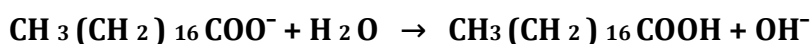
- A) use the oil to produce biofuels, such as ethanol.
- B) collect the oil properly and transport it to biodiesel production companies.
- C) periodically clean city sewers to avoid clogging and flooding.
- D) use the oil as food for fish, as it preserves its nutritional value after disposal.
- E) dispose of the oil directly into drains, sinks and manholes, without prior treatment with dispersing agents.

Answer: B

2. **(ENEM)** Soaps are salts of long-chain carboxylic acids used to facilitate, during washing processes, the removal of substances with low solubility in water, for example, oils and fats. The following figure represents the structure of a soap molecule.



In solution, soap anions can hydrolyze water and thus form the corresponding carboxylic acid. For example, for sodium stearate, the following equilibrium is established:



Since the carboxylic acid formed is poorly soluble in water and less efficient in removing fats, the pH of the medium must be controlled in order to prevent the above balance from being shifted to the right. Based on the information in the text, it is correct to conclude that soaps act in the following ways:

- A) more efficient at basic pH.
- B) more efficient at acidic pH.
- C) more efficient at neutral pH.
- D) efficient in any pH range.
- E) more efficient in acidic or neutral pH.

Answer: A

7 TOXIC WASTE RECYCLING: USE OF BATTERIES AND BATTERIES

With the development of chemistry and physics, there was a great advance in the 19th and 20th centuries in terms of the use of technologies to improve the population's quality of life. Among the widely used products are batteries, which cause great harm to human health when used inappropriately, a fact that is little publicized in the media. They are frequently used in portable radios, cell phones, computers, among other electronic devices. Due to their small size, batteries end up causing serious damage to the environment, including health problems for professionals who survive from contact with garbage (garbage collectors and street cleaners).

Technological modernization has led to an increase in the use of mercury, cadmium, nickel, lead, among other metals, in the production of these products that cause great damage to natural space. The chemical elements mentioned, in addition to affecting the central nervous system, are carcinogenic and promote genetic mutations if in intense contact with the organism. Thus, batteries are considered hazardous domestic waste and, although the importance of selective collection of this type of product is known, there must be awareness campaigns and incentives for the separation and selective collection of toxic waste.

a) Didactic approach

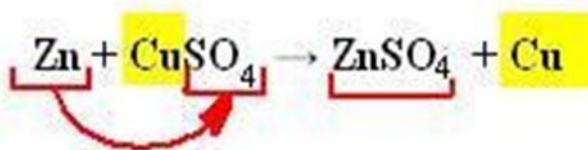
Through the process of recycling toxic waste, there is the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching chemistry. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation. In the context of the importance of recycling toxic waste, the student has the opportunity to observe the extensive consumption of batteries by today's society, the damage that these products cause to human health and the environment, the metals that go into the composition of such materials, as well as reflecting on the importance of correctly disposing of this material. In this investigative context, the student develops

skills and abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) Chemistry content: Electrochemistry - Oxidation-reduction and Electric Batteries.

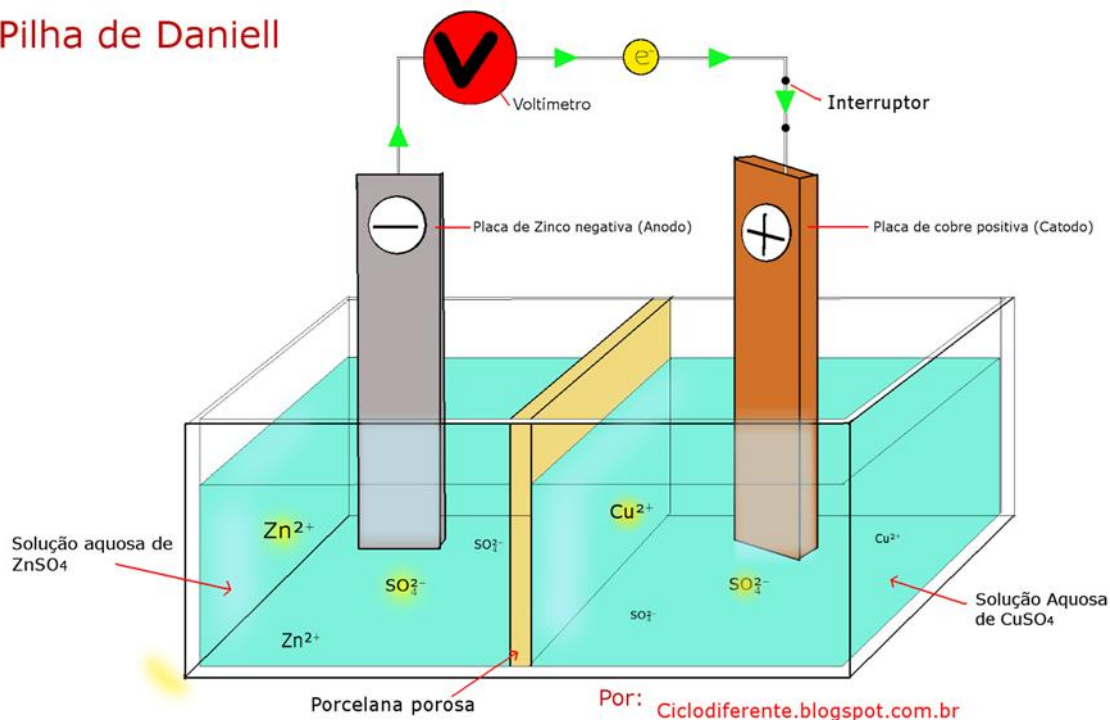
As we know, the study of redox reactions constitutes an important study within the content of chemical reactions. In these reactions, the exchange of electrons between atoms and ions is observed, which can give rise to the reduction of metallic ores, promoting the oxidation of metals and metallic alloys, in addition to studies of the biochemical redox processes that are present in the energy cycles of beings. alive. Therefore, understanding the working mechanism of batteries is of fundamental importance in understanding the contemporary world surrounded by technological devices such as portable devices, cell phones, camcorders, among others.

Among the most important concepts to be mentioned in the evolution of this content are initially the definitions of oxidation and reduction, calculation of the oxidation number, functioning and mechanism of the Daniell Cell. An easy and practical way to observe how the oxidation-reduction process works is from the reaction of a zinc sheet with a copper sulfate solution. See the reaction:



As can be seen from the reaction, when the zinc sheet is removed from the solution, it will be covered by a reddish material, which is metallic copper. Thus, to assemble a Daniell battery, we must use two solutions of zinc sulfate and copper sulfate, and it will be observed that the zinc gives up electrons to the copper through an external wire. In this way, the two compartments, as shown below, will be separated by a porous porcelain connected to a switch.

Pilha de Daniell



Source: <http://www.ciclojante.com/2014/05/as-pilhas.html>

It is worth mentioning that the chemist John Frederic Daniell (1790-1845) invented the condensation hygrometer and the electric battery described above. The researcher in question made great contributions through his studies, as he replaced the use of acidic solutions in batteries that ended up producing toxic gases with salt solutions. Salviano (2007 *apud* Saraiva, 2013, p. 177), regarding chemical reactions, suggests the use of a battery by removing the zinc from it to work on the influence of the concentration of reactants on the speed of chemical reactions. It is worth mentioning that the zinc plate on the batteries used to carry out the practices must be correctly discarded, preventing heavy metals from contaminating animal and plant specimens from nearby regions. As we know, the accumulation of zinc in the body, through the food chain, ends up causing changes in the central nervous system. Therefore, laboratory practices are of fundamental importance, as they allow students to constantly become aware of their actions in relation to the environment.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Earth and Universe unit* brings together the processes of environmental devastation and the need for sustainability of natural resources. It deals with the uses and risks of using radiation and how it affects the

biogeochemical cycles that affect the survival of living beings. Recognize the most relevant chemical aspects in the manufacture and operation of batteries, as well as the role of chemistry in guiding the appropriate disposal of this type of material as a way of ensuring the preservation of nature. Recognize the damage caused by inadequate exposure of radioactive products in places such as landfills and landfills without proper treatment through reflective reading of texts relevant to the subject.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT3103

g) From the content of Environmental Education

We live in a society where technological innovations are occurring all the time due to easy access to materials and information. In this way, the large increase in the use of cell phones, computers and portable devices has caused an excessive increase in the production and consumption of cells and batteries. The vast majority of these materials are made up of heavy metals. These metals, when accumulated in living organisms, can cause long-term damage to the nervous system, in addition to cancer problems.

Thus, the damage caused by incorrect disposal of batteries in landfills and landfills ends up causing contamination of the soil, groundwater, rivers and lakes. Therefore, it is necessary to guide young people on the importance of correctly disposing of used batteries (the National Environmental Council (CONAMA) establishes measures on the correct disposal of these products).

h) Objectives

Recognizing the need to deepen the knowledge learned in the classroom, as well as providing opportunities for active reflection on everyday actions, we propose an understanding of how the Daniell Pile works, as well as its useful applications in the student's daily life, highlighting the importance of encouraging the recycling of batteries, as a way of avoiding incorrect disposal of this material, which can cause harm to society in general and especially to waste collectors.

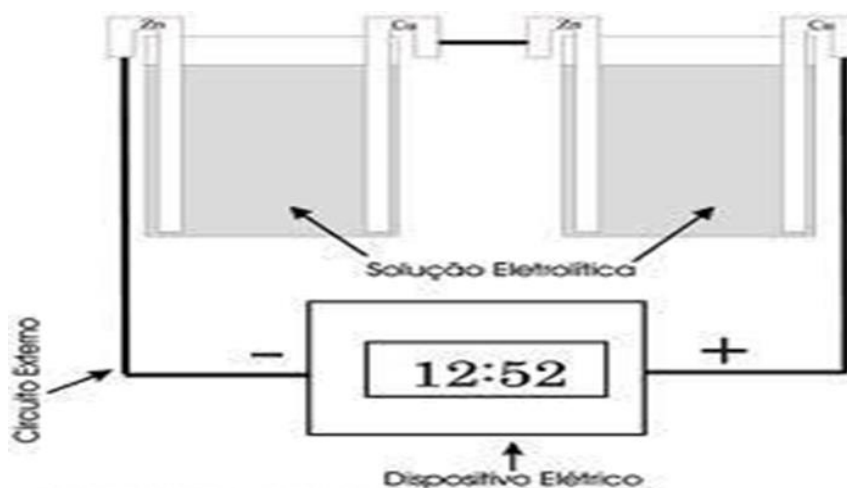


Figura 1 - Esquema da Montagem B

Source: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-46702001000100018

i) Material and methods

Materials: 01 lemon, 01 copper blade connected to a wire, 01 zinc blade connected to a wire and 01 digital clock.

Method: with both blades clean, insert them into a lemon, so that the blades do not touch. Connect the ends of the wires to the digital clock as shown below.

j) Scheduled activities

The student will have the opportunity to manufacture a battery, as well as observe the transfer of energy within the system.

k) Additional Questions

1. (ENEM) Around 1% of urban waste is made up of solid waste containing toxic elements. Among these elements are heavy metals such as cadmium, lead and mercury, a component of batteries, which are dangerous to human health and the environment. When discarded as common waste, batteries end up in landfills or open dumps, and the leakage of their components contaminates the soil, rivers and groundwater, affecting flora and fauna. Because they are bioaccumulative and non-biodegradable, these metals reach

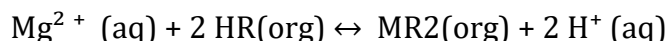
humans in an accumulated form through the food chain. Current legislation (CONAMA Resolution nº 257/1999) regulates the destination of cells and batteries after their energy depletion and determines to manufacturers and/or importers the maximum allowable quantity of these metals in each type of cell/battery, however the problem still persists.

A measure that could contribute to definitively ending the problem of environmental pollution by heavy metals reported in the text would be:

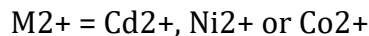
- A) Stop consuming electrical appliances that use batteries as an energy source.
- B) Use only rechargeable and long-life batteries and avoid eating contaminated food, especially fish.
- C) Return cells and batteries, after the stored energy has been exhausted, to the specialized technical assistance network for transfer to manufacturers and/or importers.
- D) Create in cities, especially those with more than 100 thousand inhabitants, strategic points for collecting batteries, for later transfer to manufacturers and/or importers.
- E) Require manufacturers to invest in research to replace these toxic metals with substances that are less harmful to humans and the environment and that are not bioaccumulative.

Answer: E

2. (ENEM) Ni-Cd batteries widely used in our daily lives should not be disposed of in common waste, since a considerable amount of cadmium is volatilized and emitted into the environment when spent batteries are incinerated as a component of waste. In order to avoid the emission of cadmium into the atmosphere during combustion, it is recommended that materials from these batteries be recycled. One way to separate cadmium from other compounds present in the battery is to carry out the acid leaching process. In it, both the metals (Cd, Ni and eventually Co) and the hydroxides of metal ions $\text{Cd}(\text{OH})_{2(s)}$, $\text{Ni}(\text{OH})_{2(s)}$, $\text{Co}(\text{OH})_{2(s)}$ present in the battery, react with an acidic mixture and are solubilized. Due to the low selectivity (all metal ions are solubilized), after acid digestion, a metal extraction step is carried out with organic solvents according to the reaction:



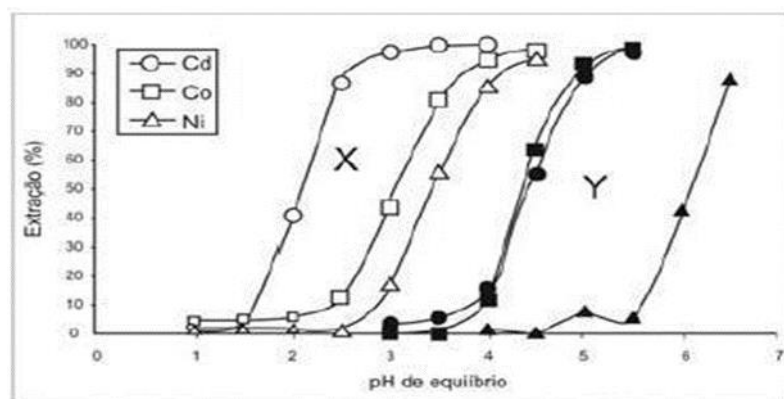
Where:



HR = C₁₆H₃₄ -PO₂H: identified on the graph by **X**

HR = C₁₂H₁₂ -Po₂h: identified on the graph by **Y**

The graph shows the results of the extraction using organic solvents **X** and **Y** at different pH.



The reaction described in the text shows the process of extracting metals through reaction with organic molecules, **X** and **Y**. Considering the structures of **X** and **Y** and the separation process described, it can be stated that:

- A) molecules **X** and **Y** act as cationic extractors since the polar part of the molecule exchanges the H⁺ ion for the metal cation.
- B) molecules **X** and **Y** act as anionic extractors since the polar part of the molecule exchanges the H⁺ ion for the metal cation.
- C) molecules **X** and **Y** act as cationic extractors since the nonpolar part of the molecule exchanges the PO₂ ion for the metal cation.
- D) molecules **X** and **Y** act as anionic extractors since the polar part of the molecule exchanges the PO₂ ion for the metal cation.
- E) molecules **X** and **Y** form bonds with metallic ions resulting in compounds with a non-polar character, which justifies the effectiveness of the extraction.

Answer: A

8 PLASTIC RECYCLING

Plastics are carbon chain polymers of synthetic or petroleum origin. Polymers, being composed of long chains of ethylene monomers, present characteristics favorable to the production and use of this product on a large scale. Research shows that in Brazil, an average of thirty kilos of plastic is consumed per inhabitant, generating extensive waste production that ends up in landfills or landfills. Within this context, encouraging the selective separation of plastic and its selective collection allows many families that survive by collecting this material to have their daily food guaranteed. Thus, this process ends up reducing the amount of recycled waste that ends up in landfills, increasing its useful life.

a) Didactic approach

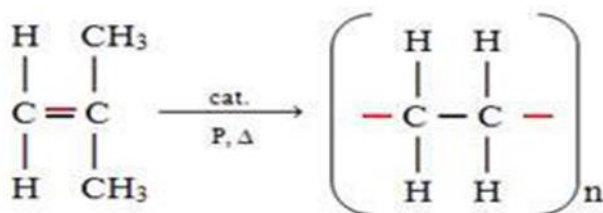
Through the plastic recycling process, there is the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching this discipline. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation.

In this context, students have the opportunity to reflect on the importance of plastic recycling, both in terms of preserving natural space and reducing the amount of waste deposited in landfills. It is also important to highlight that within the concept of sustainability, the plastic recycling process guarantees many families survival conditions, even if it is in precarious conditions. In this investigative context, the student develops skills and abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) Chemistry content: Addition Polymer

The word “plastic” comes from the Greek “plastikos” which means suitable for modeling. Discovered at the end of the 19th century, this material has been continuously used to replace the use of bones and horns, which were raw materials for the manufacture of combs, buttons and piano keyboards. Thus, plastics are artifacts produced from synthetic polymers, derived from petroleum, being artificial materials of organic origin that, during their manufacture, acquire the desired shape depending on the intensity of heat and pressure to which they are exposed. This material is of organic, artificial origin and is frequently used in modern society due to its low cost, malleability and high resistance.

Polymers are macromolecules obtained by joining monomers in a process called polymerization. Its first synthesis took place in 1864 with the manufacture of celluloid. In 1909, the development of a more resistant plastic resin called Bakelite. Polymers can be classified as natural and artificial. The biggest problem faced today in relation to plastic is the increase in the amount of waste generated, since these products have a long lifespan. Brazil has been producing the so-called green plastic, which is polyethylene from ethyl alcohol, using sugar cane as its raw material. Thus, green polyethylene aims to replace polyethylene made from fossil fuel, favoring the reduction of carbon dioxide produced, being produced from a synthetic ethanol resin and allowing the manufacture of fuel tanks, diaper films, plastic containers for dairy products, among others.



c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, promoting understanding of the addition polymerization process. The *Earth and Universe* unit brings together the processes of environmental

devastation and the need for sustainability of natural resources. It deals with the uses and risks of using radiation and how it affects the biogeochemical cycles that affect the survival of living beings. Identify the damage caused by inappropriate disposal of plastics in landfills and landfills, as well as understand the importance of recycling.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105/EM13CNT302

g) Environmental Education content

Problems related to solid waste arose when man began to take up residence, abandoning his nomadic life. Ancient civilizations deposited their trash in remote areas or threw it into rivers, streams, lakes and vegetation. Today, we can see that a part of the population continues to spread this same custom.

Currently, the great challenge facing public bodies (city hall and states) is related to the final disposal of waste such as plastic, which due to its chemical constitution presents great resistance to biodegradation, which has led to the accumulation of this material on the streets, in landfills and landfills, promoting increased pollution and the spread of diseases. A solution to this problem, which is gaining support, consists of reusing plastics discarded in domestic waste and commercial outlets, reducing the total volume of waste. The main problems related to plastic and its accumulation in landfills are due to the practice of burning that releases dioxins into the atmosphere, occupying immense spaces, which harms the decomposition of biodegradable materials, creating impermeable layers that affect the exchange of liquids and gases. generated in the biodegradation process. According to Saraiva (2013, p. 177), attitudes such as the reuse of PET materials contribute to reducing waste, since, due to the rush of the majority of the population and the convenience of not having to return the container, the consumption of these bottles is more intense than than glass containers.

Thus, encouraging recycling and selective collection has helped to reduce the amount of waste disposed of in cities, as well as promoting an increase in the useful life of landfills.

h) Objectives

Recognizing the need to deepen the knowledge learned in the classroom, as well as providing an opportunity for active reflection on everyday actions, it is proposed to understand how the addition polymerization process works in plastic manufacturing, as well as its useful applications in everyday life. student day, highlighting the importance of encouraging the recycling of plastic materials, as a way of avoiding incorrect disposal of this material, which can cause harm to society in general, especially the spread of diseases.

i) Material and methods

Materials: Polyvinyl acetate (water-soluble white glue), Borax (sodium tetraborate decahydrate), water, food coloring, wooden stick (ice cream stick), 01 plastic coffee spoon, 03 disposable juice cups (large cup), 03 disposable coffee cups (small cups), 01 pair of rubber gloves.

Method: put on rubber gloves and prepare a 4% aqueous borax solution. To do this, you have to dilute 4g of borax in 96g of water. In the absence of precision measuring devices, do the following procedure: put 2 small glasses of water in a large glass and add a teaspoon (not too full) of borax. Stir well until the solid dissolves. An aqueous borax solution with a mass strength of approximately 4% is ready.

Leave the aqueous borax solution in reserve and prepare a 50% PVA solution (in a 100 ml solution (large glass) add 50 ml of water and 50 ml of white glue). Stir with an ice cream stick until the mixture is homogeneous and add a few drops of food coloring in your favorite color. Now place equal parts of solutions 1 and 2 in a third glass (use a small glass as a measure). What happened? You can take the mixture out of the cup and handle it with your hands. If you want to store the mixture, place it in a container with a lid.

Note: using rubber gloves is of fundamental importance, as borax in contact with the skin causes irritation, redness, pain and itching. Contact with the respiratory tract can cause irritation, followed by coughing, and its ingestion causes nausea, vomiting, diarrhea and can lead to death.

Waste disposal: Throw the mixture in regular trash, never in the sink or toilet.

j) Scheduled activities

The student will have the opportunity to understand and explain the solubility of PVA in water, observe the consistency of the solution formed as well as reflect more deeply on the importance of correct disposal of materials, in order to promote environmental conservation as proposed by the PCNs and DCNEM.

k) Additional Questions

1. (ENEM) Plastics, due to their versatility and lower relative cost, are increasingly used. Of the Brazilian annual production of around 2.5 million tons, 40% is destined for the packaging industry. However, this growing increase in production and consumption results in waste that is only reintegrated into the natural cycle over decades or even centuries. To minimize this problem, a possible and appropriate action is:

- A) ban the production of plastics and replace them with renewable materials such as metals.
- B) incinerate the waste so that carbon dioxide and other products resulting from combustion return to natural cycles.
- C) burn the garbage so that the toxic and non-degradable additives contained in the composition of plastics are diluted in the air.
- D) encourage the production of recyclable plastics to reduce the demand for non-renewable raw materials and the accumulation of waste.
- E) recycle the material to increase the quality of the product and facilitate its large-scale commercialization.

Answer: D

2. (ITA - SP) In the statements below, macromolecules are related to the process known as vulcanization. Select the option that contains the correct statement:

- A) The elastomer obtained from butadiene-1,3 and styrene (vinylbenzene) does not lend itself to vulcanization .

- B) The devulcanization or recycling of tires is based on the action of concentrated sulfuric acid, in the presence of oxygen and at high temperature, on the vulcanized rubber.
- C) During vulcanization, polymers receive a filler of limestone and pitch, which makes them resistant to heat without loss of elasticity.
- D) Vulcanized polymers will only be elastic if the concentration of vulcanizing agent is not excessive.
- E) From butadiene-1,3 a polymer is obtained which, as long as it is not vulcanized, will be thermosetting

Answer: D

3. (ENEM) One of the processes used in waste treatment is incineration, which has advantages and disadvantages. In São Paulo, for example, garbage is burned at high temperatures and part of the energy released is transformed into electrical energy. However, incineration causes pollutants to be emitted into the atmosphere. One way to minimize the disadvantage of incineration, highlighted in the text, is:

- A) Increase the volume of waste incinerated to increase energy production.
- B) Encourage the use of filters in incinerator chimneys to reduce air pollution.
- C) Increase the volume of waste to reduce operational costs related to the process.
- D) Promote selective waste collection in cities to increase the volume of incinerated waste.
- E) Reduce the temperature at which waste is incinerated to produce a greater amount of electrical energy.

Answer: B

9 OZONE LAYER

Ozone is a dark blue atmospheric gas that concentrates in the stratosphere layer, located between 20 and 40 km above sea level. This layer has the function of protecting the Earth against the sun's ultraviolet rays, which are harmful to human health. Ultraviolet radiation (UV) has wavelengths ranging between 0.1 and 0.4 μm and can cause damage to human cells when not absorbed by the ozone layer.

In this process, oxygen gas molecules absorb ultraviolet light, producing oxygen atoms. The photodissociation of ozone by visible and ultraviolet light produces molecular oxygen and oxygen atoms, and its decomposition is largely due to pollution, which can significantly contribute to the reduction of its concentration in the stratosphere. One of the chemical elements responsible for its decomposition is chlorine, which reaches this layer through halogenated organic compounds, such as CFC's, responsible for breaking down the ozone molecule, increasing what is known as a hole in the ozone layer. They are mainly found in refrigeration equipment. Thus, the Brazilian Ozone Layer Protection Program's mission is to coordinate and supervise the operation of CFC-based refrigerators, encouraging their progressive replacement.

a) Didactic approach

By compressing the process of formation and decomposition of the ozone layer, there is the opportunity through the study of chemistry to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching chemistry. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation.

In this context, students have the opportunity to reflect on the importance of the ozone layer for the survival of life on Earth, understand the reactions between halogenated compounds and ozone gas, as well as the importance of environmental protection programs. Since chemistry is a science whose current proposal leads to contextualized work, studying aspects that refer to the preservation of natural space becomes fundamental. In this investigative context, the student develops skills and

abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) Chemistry content: Formation of the Ozone molecule

The ozone layer, located in the stratosphere, is formed by the union of three oxygen atoms that form ozone (O_3). This has the function of protecting the Earth against the sun's ultraviolet rays. Because the ozone molecule is unstable due to the dative covalent bond, it easily joins molecules such as CFCs, creating O_2 plus $\frac{1}{2}$ of O_2 . Thus, the high energy radiation from the sun not only creates but breaks down ozone molecules, causing the O_3 breakdown process to increase, increasing what we call spaces or holes. See below the reaction of formation and destruction of the ozone layer.

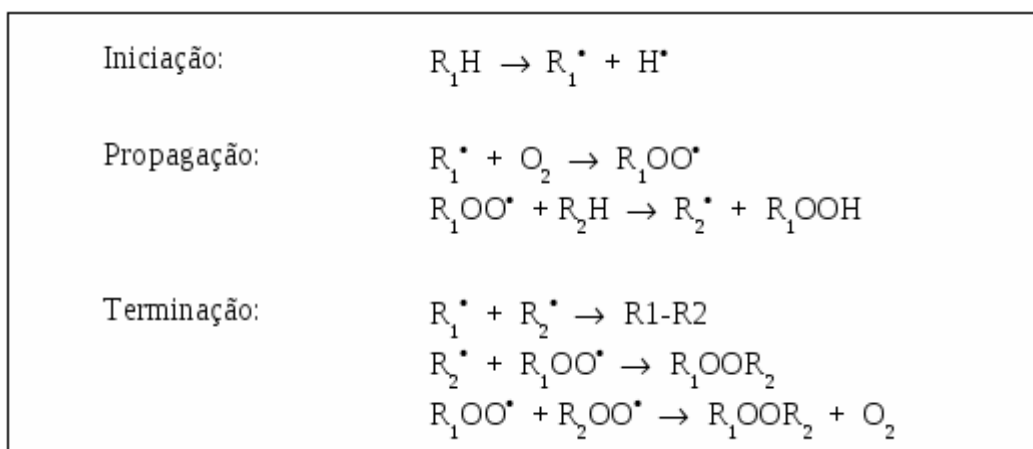
If the ozone layer is destroyed, life on planet Earth would be compromised. The UV-B radiation spectrum has a wavelength between 280 – 315 nanometers, which is harmful to all forms of life, as it causes skin burns and can cause genetic mutation, corneal inflammation and cataracts, as well as reduced protection. by the immune system.

Another important factor regarding the ozone layer is that it functions as a regulator of the planet's temperature. Thus, the first warning about problems linked to the ozone layer occurred in 1982, when a group of scientists discovered what appeared to be a hole in the ozone layer.

It is worth mentioning that the burning of fossil fuels releases compounds that, when reacting with sunlight, form ozone. This production close to the surface causes respiratory problems in humans, in addition to harming flora and fauna. The best-known effect of ozone in regions close to the surface is the deterioration of rubber, changes in the color of paintwork in general, among others. Therefore, some stable chemicals produced by humans have the ability to bind to the ozone molecule, such as bromine and chlorine, breaking down the ozone molecule.

The formation of a free radical occurs from an energy source (heat, UV radiation). The energy source breaks the chemical bond between carbon and hydrogen adjacent to the CC double bond. This break occurs because the double bond is sterically more exposed and susceptible to radiation. The free radical formed by UV radiation can

react with the oxygen present, forming new free radicals, mainly the peroxide radical, which is very reactive.



Upon termination, the free radicals formed can bond with each other, forming the most diverse products, such as hydrocarbons, aldehydes, alcohols, esters, etc.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, recognizing the most relevant chemical aspects in the process of formation and destruction of the ozone layer, the consequences of human intervention in the environment, as well as the role of chemistry in the preservation of natural resources. *The Earth and Universe* unit brings together the processes of environmental devastation and the need for sustainability of natural resources. Know the chemical reactions involved in the process of formation and destruction of the ozone layer, production of manufactured goods such as CFC and their action against the ozone molecule, as well as the proposal of actions that aim to contain this process.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT103/EM13CNT302

g) Environmental Education content

Talking about this subject leads us to reflect on the importance of environmental education, as the existence of the Ozone Layer is one of the fundamental conditions for the existence of life on planet Earth. This is responsible for filtering the sun's ultraviolet rays that cause diseases such as skin cancer and cataracts. Taking care of nature also consists of taking care of human beings in their physical, organic and emotional complexity.

With the advent of the industrial revolution and the production of manufactured products, such as CFC (chlorofluorocarbon) used in refrigeration devices, it is released into the environment and, when reacting with the ozone molecule (O_3), promotes its breakage. The most aggravating fact within this process is the fact that the formation of ozone requires a favorable environment, requiring a high energy level for the reaction to take place. Thus, school units play a fundamental role in this process of promoting ecologically correct actions, in order to strengthen actions aimed at preserving natural resources as established by the PCNs and DCNEM.

h) Objectives

Recognizing the need to deepen the knowledge learned in the classroom, as well as providing opportunities for active reflection on everyday actions, it is proposed to understand how the process of formation and destruction of the ozone layer works, as well as the damage caused by short, medium and long term, as a way to avoid the abusive use of this substance that promotes the breakdown of the ozone molecule. This work will promote the manufacture of a natural sunscreen as a way to protect the skin against excessive exposure to the sun

i) Material and methods

Materials: 04 tablespoons of sesame oil, 2 tablespoons of avocado oil, 2 tablespoons of jojoba oil, 1 tablespoon of zinc oxide, 1 tablespoon of beeswax melted in a bain-marie.

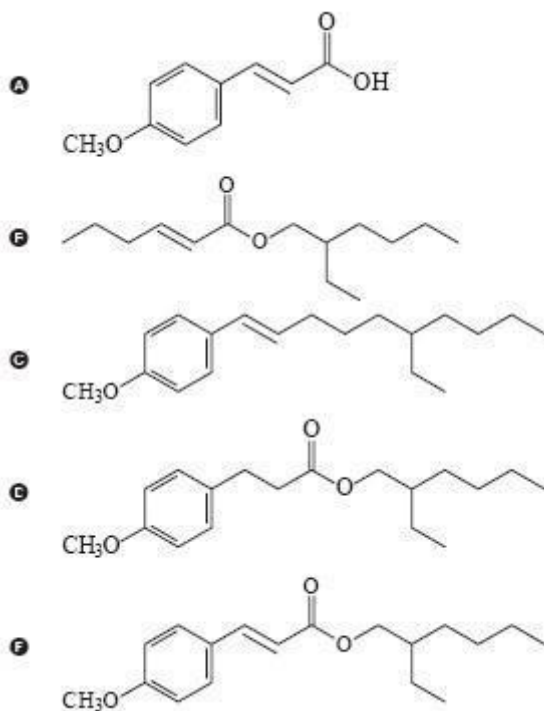
Method: Mix the oil and melted beeswax. Add zinc oxide and mix well. Ready and store in a thermal container. Without beeswax, it is more flexible and needs to be shaken well before each use.

j) Scheduled activities

The student will have the opportunity to understand and explain the action of compounds such as CFC's and their reaction in the presence of ozone, observe their effects, as well as the importance of deepening the subject in question, in order to avoid environmental and organic problems, such as the emergence of diseases in order to promote the conservation of the space in which we live, since human beings are part of this great complex that we call nature, as proposed by the PCNs and DCNEM.

k) Additional Questions

1. (ENEM) The use of sunscreens in situations of great exposure to sunlight, such as on beaches, is of great importance for health. The active molecules of a protector usually have aromatic rings conjugated with carbonyl groups, as these systems are capable of absorbing the ultraviolet radiation that is most harmful to humans. Conjugation is defined as the occurrence of alternation between single and double bonds in a molecule. Another property of the molecules in question is that they present, at one of their ends, a non-polar part responsible for reducing the solubility of the compound in water, which prevents its rapid removal upon contact with water. According to the considerations in the text, which of the molecules presented below is the most suitable for function as an active molecule in sunscreens?



Answer: E

2. **(ENEM)** The label of an aerosol deodorant informs the consumer that the product contains isobutane, butane and propane gases, among other substances. In addition to this information, the label also bears the inscription “Does not contain CFC”. The following reactions, which occur in the stratosphere, justify not using CFC (chlorofluorocarbon or Freon) in this deodorant:



Concern about possible threats to the ozone layer (O_3) is based on its main function: protecting living matter on Earth from the harmful effects of ultraviolet solar rays. The absorption of ultraviolet radiation by stratospheric ozone is intense enough to eliminate much of the ultraviolet fraction that is harmful to life. The purpose of using isobutane, butane and propane gases in this aerosol is:

A) replace CFC, as it does not react with ozone, serving as propellant gases in aerosols.

B) serve as propellants, as they are very reactive, they capture free Freon in the atmosphere, preventing the destruction of ozone.

C) react with air, as they spontaneously decompose into carbon dioxide (CO_2) and water (H_2O), which do not attack ozone.

D) prevent the destruction of ozone by CFC, as gaseous hydrocarbons react with UV radiation, releasing hydrogen (H_2), which reacts with oxygen in the air (O_2), forming water (H_2O).

E) destroy CFCs, as they react with UV radiation, releasing carbon (C), which reacts with oxygen in the air (O_2), forming carbon dioxide (CO_2), which is harmless.

Answer: A

10 THE USE OF OIL: MANUFACTURING OF MANUFACTURING AND ENVIRONMENTAL PROBLEMS

Oil originates from animal and plant beings, mainly of marine origin, which were buried millions of years ago and which suffered decomposition by microorganisms, high temperatures and pressure. As oil is classified as a non-renewable resource in the short term, this dark and viscous liquid can be considered one of the main components of modern life. From oil we obtain natural gas, gasoline, diesel oil, kerosene, plastics, asphalt, among other byproducts. Its extraction process takes place through the fractional distillation of oil. It is worth mentioning that its combustion process increases the concentration of carbon monoxide and carbon dioxide, responsible for increasing the greenhouse effect. The combustion of oil also releases sulfur compounds into the atmosphere, which will contribute to the formation of acid rain. Thus, controlling the emission of polluting gases aims to help maintain the quality of life on the planet.

a) Didactic approach

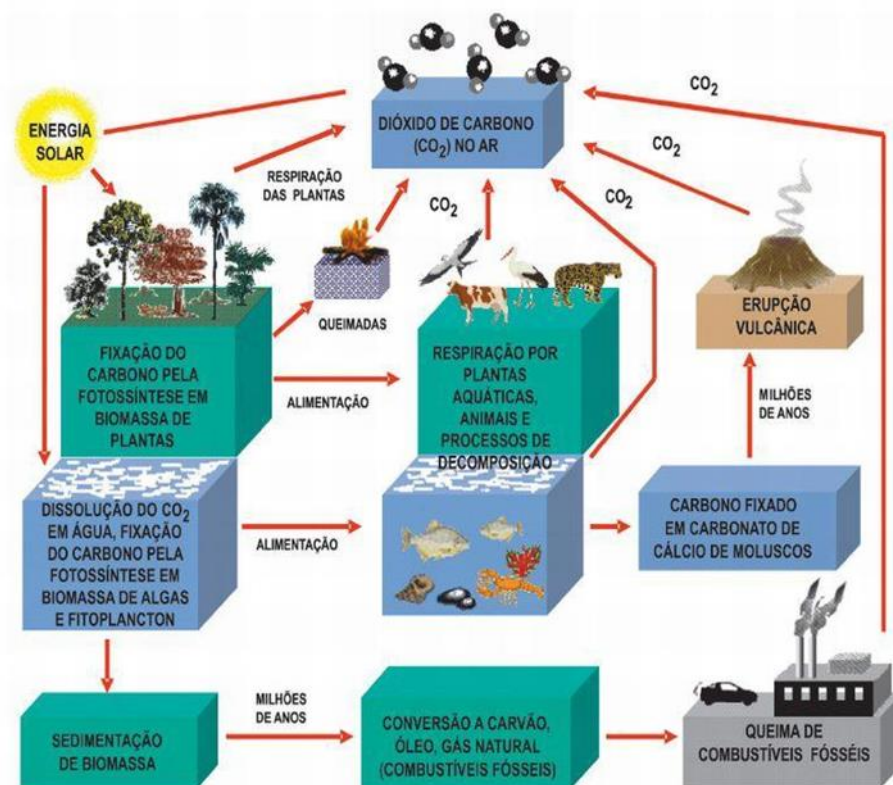
By understanding the oil formation process, one has the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching this discipline, helping to preserve natural resources. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation. In this context, the student has the opportunity to reflect on the oil formation process, its importance in the context of contemporary life, the amount of waste produced from its by-products and how to help preserve natural space. In this investigative scenario, the student develops skills and abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) Chemistry content: Formation of oil and generation of waste

The word petroleum comes from Latin and means stone oil, being so named because its material is extracted from rocks. Petroleum is a hydrocarbon of organic origin, formed from decomposing animal and vegetable remains, both in marine and continental environments. In this way, the action of microorganisms on this material, combined with high temperatures and pressure, which has been buried for millions of years, favors the formation of a dark and viscous liquid that we know as petroleum. Still considered today the main natural product used in contemporary society, it is classified as a non-renewable resource in the short term, due to the fact that its formation is slow and requires a favorable environment.

Thus, oil is found in places called pockets, located on land and at the bottom of the oceans. According to statistical data provided by Ricardo Feltre's book, it is believed that around 50% of the world's oil deposits are under the sea. Its extraction can be done in several ways, including the classic method which consists of the use of explosives, followed by measuring the shock waves that are reflected in the subsoil and reference to the possibility of the existence of oil. Currently, artificial satellites are used that indicate, with greater probability, the places where there is a greater possibility of finding oil.

Oil, after being extracted, is subjected to a process called cracking, which is a complex process where alkane molecules break down into increasingly smaller molecules. Therefore, through the use of catalysts through heating, the process called *reforming* allows the transformation of normal chain hydrocarbons into branched, cyclic and aromatic hydrocarbons. In this way, oil is transported to large urban centers, being the raw material for the manufacture of various products such as gasoline, natural gas, diesel, plastics and rubber, in addition to generating a large amount of solid waste (garbage) that has promoted the atmospheric pollution and the strengthening of problems such as global warming, respiratory problems, among others.



Source: <http://qnint.sbq.org.br/qni/visualizarTema.php?idTema=7>

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, recognizing the most relevant chemical aspects in the oil formation process and the consequences of human intervention in the environment, as well as the role of chemistry in preserving natural resources. The *Earth and Universe* unit brings together the processes of environmental devastation and the need for sustainability of natural resources. Know the chemical reactions involved in the processing of oil into manufactured products, the generation of solid, liquid and gaseous waste, as well as the proposal of actions that aim to contain the damage caused to the environment.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105/EM13CNT302/ EM13CNT208

g) Environmental Education content

As we know, oil is one of the main sources of raw materials that sustain modern life, providing a variety of products that, through industry and manufacturing production, reach the consumer. The fact is that we live in a society that values the production of consumer goods, and the profit that can be obtained through this process. Thus, there is an increase in the production of solid waste (garbage), an increase in the combustion processes of petroleum products that release a high concentration of carbon dioxide into the atmosphere, intensifying the process of global warming and, as a consequence, the change in the global climate scale.

h) Objectives

Due to the need to guarantee sustainability with a view to conserving natural resources for future generations, this study aims to deepen the knowledge learned in the classroom, as well as providing opportunities for active reflection on everyday actions. Thus, the student will have the opportunity to understand and determine the amount of alcohol in a given sample of gasoline, make its percentage determination, understand the notions about polarity of molecules, as well as the standards brought by the National Petroleum Agency.

i) Material and methods

Materials: 10 ml of gasoline, 10 ml of water, 25 ml beaker .

Method: Take the 25 ml beaker and place 10 ml of gasoline and 10 ml inside it. Shake the mixture and let it rest for about 10 minutes. Thus, the alcohol volume can be calculated by the difference between the initial volume of the gasoline mixture with alcohol and the final volume (corresponding only to gasoline). The result is obtained by reading the volumes in the beaker after adding water. The difference in volume will be used to determine the percentage calculation of the amount of alcohol present in gasoline. It is worth mentioning that the National Petroleum Agency determines that the alcohol content in gasoline must be 22% to 26%.

$$\text{Volume \% alcohol} = \frac{\text{volume of alcohol in gasoline} \times 100\%}{\text{initial gasoline volume}}$$

j) Scheduled activities

In addition to the student having the opportunity to understand and determine the amount of alcohol in a given sample of gasoline, make its percentage determination and understand the notions about polarity of molecules, they will observe its effects, as well as the importance of deepening the subject in question in order to avoid environmental problems as proposed by the PCNs and DCNEM.

k) Additional Questions

1. (ENEM) To understand the process of exploration and consumption of petroleum resources, it is essential to know the genesis and formation process of petroleum described in the text below.

"Oil is a fossil fuel, probably originating from the remains of aquatic life accumulated at the bottom of the primitive oceans covered by sediments. Time and the pressure of the sediment on the material deposited on the seabed, transformed these remains into viscous black masses called oil deposits" (Adapted from TUNDISI. Uses of energy. São Paulo: Atual Editora, 1991).

- A) oil is a short-term renewable energy resource, due to its constant geological formation.
- B) oil exploration is carried out only in marine areas.
- C) the extraction and use of oil are non-polluting activities given its natural origin.
- D) oil is an energy resource distributed homogeneously, in all regions, regardless of its origin.
- E) oil is a non-renewable resource in the short term, explored in continental areas of marine origin or in underwater areas.

Answer: E

2. (ENEM) “The stone age came to an end, not because of a lack of stones; The oil era will also come to an end, but not for lack of oil.” Sheikh Yamani, Former oil minister of Saudi Arabia.

Considering the characteristics that involve the use of the raw material mentioned in the text in different historical-geographical contexts, it is correct to state that, according to the author, like what happened in the stone age, the end of the oil era would be related :

- A) The reduction and depletion of oil reserves.
- B) Technological development and the use of new energy sources
- C) The development of transport and consequently an increase in energy consumption
- D) Excess production and consequent devaluation of the barrel of oil.
- E) The decrease in human actions on the environment.

Answer: B

3. (ENEM) Gasoline is sold by the liter, but, when used as a fuel, the mass is what matters. An increase in ambient temperature leads to an increase in the volume of gasoline. To reduce the practical effects of this variation, gas station tanks are underground. If the tanks were not underground:

- I. You would have an advantage when fueling your car at the hottest time of the day, as you would be buying more mass per liter of fuel.
- II. By refueling at a lower temperature, you would be purchasing more fuel for each liter.
- III. If gasoline were sold by kg instead of by liter, the commercial problem arising from the expansion of gasoline would be solved.

Of these considerations, only:

- A) I is correct
- B) II is correct
- C) III is correct
- D) I and II are correct
- E) II and III are correct

Answer: E

11 REUSE OF TIRE DUST: VULCANIZATION PROCESS

The population increase, the development of industry and the great diversity of products produced with the aim of facilitating modern life, as well as the culture that values the non-reuse of consumed materials, has led current society to an imminent collapse with regard to the production of waste, which largely ends up in landfills, places where diseases are transmitted. One of the problems of today's society is the disposal of tires, the vast majority of which are left abandoned on the streets, in abandoned lots, among other inappropriate places. The simple abandonment of this material promotes, among others, the accumulation of water which, during rainy seasons, becomes a public health problem, spreading diseases such as dengue fever (transmitted by *Aedes Aegypti*, the disease's vector agent). The tire vulcanization and recycling process aims to contribute to composting, in addition to helping to remove these materials from places unsuitable for their packaging.

a) Didactic approach

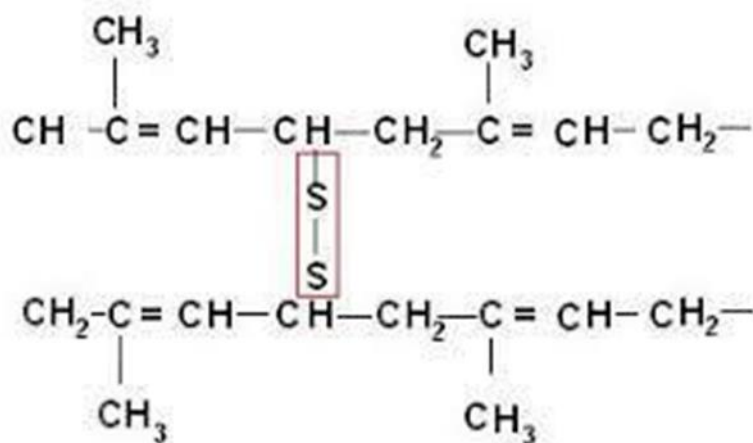
Through the tire recycling process, there is the opportunity, through the study of chemistry, to test and evaluate strategies through research study, seeking to implement the pedagogical practice of teaching this discipline. Chemical science, through its investigative nature, promotes experience, reflection and enhances learning. It is worth highlighting that the reflection on the investigative nature of chemistry teaching is related to the proposal of strategies that assist in the teaching-learning process through experimentation.

In this context, the student has the opportunity to reflect on the importance of tire recycling (composting), both in terms of preserving natural space and reducing the amount of waste going to landfills and landfills. It is also important to highlight that, within the concept of sustainability, the recycling process guarantees many families survival conditions, even if it is in precarious conditions. In this investigative context, the student develops skills and abilities that will be used by them throughout their school life and even in their professional life. Thus, in teaching chemistry through investigation, the student interacts, explores and experiences the natural world, becoming the protagonist of their own learning.

b) From the Chemistry content: Synthetic Polymers

Polymers are macromolecules obtained from the union of small molecules called monomers. These are classified as natural and artificial, as is the case with plastic. Thus, plastics are artificial polymers of organic origin that at some stage of their manufacture acquired shape due to exposure to pressure and heat. Therefore, due to the need to serve the consumer market, Charles Goodyear invented the process known as vulcanization in 1839, which consisted of a process that allowed natural rubber to be used industrially, due to its high resistance. Thus, the vulcanization process consists of adding sulfur to the rubber in a percentage that varies between 2% and 30%. In this process, catalysts such as litharge (PbO) are used, which causes some double bonds to open, allowing the formation of bridges made up of sulfur atoms forming a three-dimensional polymer.

A constant concern of environmentalists is related to the quality of the environment, which is rapidly deteriorating; concern focused on tires discarded in nature, as their chemical composition includes: carbon (70.0%), hydrogen (7.0%), zinc oxide (1.2%), sulfur (1.3 %), iron (15.0%) and other pollutants (5.5%). The tire is considered a manufactured product that brings great harm to the environment, since its disposal is most often done incorrectly, where they are thrown outdoors in fields, rivers, lakes, streams, among others, without any prior treatment, which is the object of disease transmission. In addition to the terrible appearance they leave on the landscape, tires accumulated in landfills are considered harmful to the environment and public health as they accumulate trash and serve as breeding grounds for dengue mosquito larvae. Open-air incineration is considered dangerous by environmentalists, as it releases large amounts of sulfur dioxide and carbon that are harmful to the ozone layer. The environmentally friendly burning of tires is done in industrial machines, which filter polluting smoke.



c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, recognizing the most relevant chemical aspects in the process of formation of Synthetic Polymers and how this product is present in everyday life. The *Earth and Universe unit* brings together the processes of environmental devastation and the need for sustainability of natural resources. Know the chemical reactions involved in the rubber vulcanization process, the importance of Charles Goodyear in this process as well as the damage caused by inappropriate disposal of this material.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105/EM13CNT302/ EM13CNT208

g) Environmental Education content

Introduction

Due to the fact that a tire takes 600 years to decompose, recycling it brings several benefits. Among them, we can mention its use in the manufacture of flooring, thermal and acoustic insulation, soil stabilization for civil construction, in addition to the manufacture of rubber products and even as a remanufactured tire, which gives it high grip and resistance.

Recycling this material is capable of returning a regenerated input to the production process for less than half the cost of natural or synthetic rubber. With the

paste resulting from tire crushing, industries produce car mats, shoe soles, industrial flooring and sealing rubber, among others. The dust generated during retreading and the remains of ground tires can be applied to the asphalt composition with greater elasticity and durability, in addition to acting as an aerator element for compacted soils and piles of organic compost. Nowadays, one of the main activities related to tire recycling is the retreading of used tires.

h) Objectives

Due to the need to guarantee sustainability with a view to conserving natural resources for future generations, this study aims to deepen knowledge about the production of synthetic polymers, as well as provide opportunities for reflection on the damage caused by inappropriate tire disposal to the environment.

i) Material and methods

Materials: Used tire.

Method: The tire recovery process first consists of separating the vulcanized rubber from other components, such as metals and fabrics. Soon after, the tire is cut into chips and purified. The chips are ground and then subjected to digestion in water vapor and chemical products, such as alkalis and mineral oils, to devulcanize them. The product obtained from this process is refined in mills to obtain rubber granules that can be used to manufacture car mats, sports courts, glues, adhesives, among others.

j) Scheduled activities

The student will have the opportunity to understand how the process of manufacturing synthetic polymers takes place, as well as learn more deeply about the rubber vulcanization process and the contributions of Charles Goodyear in deepening the subject in question, in order to avoid environmental problems such as proposed by the PCNs and DCNEM.

k) Additional Questions

1. (UFS Carlos) Natural rubber is an elastomer (elastic polymer), which is obtained from the coagulated latex of *Hevea brasiliensis*. Its elastic properties improve when heated with sulfur, a process invented by Charles Goodyear, named after:

- A) Roasting
- B) Vulcanization
- C) Distillation
- D) Synthesis
- E) Galvanization

Answer: B

2. (Ufu) Polymers are organic macromolecules built from many small, repeating units called monomers. Select the alternative that only contains natural polymers.

- A) Cellulose, plastic, polystyrene.
- B) Starch, protein, cellulose.
- C) Starch, nylon, polyethylene.
- D) Plastic, PVC, teflon

Answer: B

12 PRODUCTION OF ESSENTIAL OIL FROM THE *ROSA ALBA L* ENFLEURAGE PROCESS.

Oxygenated functions are organic compounds that contain oxygen linked to a hydrocarbon. These functions are directly linked to the production of essential oils and perfumes, and the flavor and aroma of compounds that we use in our daily lives. Therefore, this pedagogical proposal aims to address the production of essential oils, based on a concrete experience experienced by students in the production of essential oils using the *Rosa Alba L*.

The word perfume derives from the Latin “*per fumum*” which means “through smoke” and has its origins linked to incense, used by ancient civilizations to soften smells. For this reason, perfumes were initially reserved for the gods, as they cause a certain elevation of spirit in man. It thus began to be used by priests and kings. Studies show that in Ancient Egypt, whose traditions were focused on alchemy and philosophy, they used essential oils in the healing and embalming process. In the temple of Horus in 237 BC, scented candles were found.

The great Egyptian discovery of the enfleurage process, extraction of perfume from aromatic flowers, in contact with vegetable oils. Thus, Egyptian nobles adopted the habit of passing essential oils over their bodies as a muscle relaxant. Greek athletes used essential oils before the Olympic games, and the Roman Empire bowed to the benefits of aromatic oils, being considered a luxury item for Roman society. The Arabs, realizing the reach of the aforementioned spice, began to commercialize it, which accelerated the process of diffusion of essential oils and perfumes throughout the world. Currently, France is a world reference in the manufacture of the best perfumes, due to their treatment and concentration.

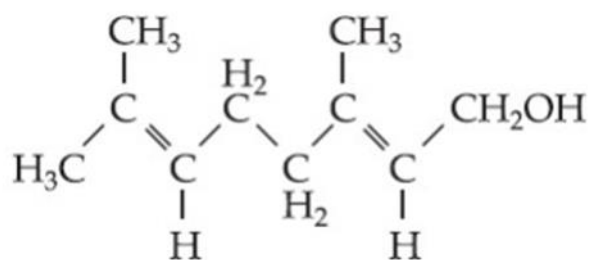
a) Didactic approach

The products obtained from the distillation process were used to flavor environments, especially in citizenship classes where students took care to prepare the environment to welcome their classmates and share constructions and experiences with them. Perfumes and essential oils have accompanied humanity for centuries. Vases containing essential oils were found in the tombs of the pharaohs, Cleopatra perfected

several types of perfumes, being one of the great supporters of their production, Master Jesus received incense (a type of perfume) from the three Magi at the time of his birth. Finally, perfumes and essential oils have always been considered, throughout history, gifts of a divine nature whose potential consists of harmonizing and purifying, a finding obtained over generations.

Alchemists were very concerned with its production, dedicating hours to perfecting techniques in the distillation and extraction process. The fragrance of an essential oil and perfume results from a complex mixture of substances originally extracted from plants and flowers. Therefore, obtaining essences directly from flowers is an expensive and delicate process. Jasmine, for example, its petals are light and need treatment after harvesting in order to preserve the aroma present there. To make one kilo of essence, five million jasmine flowers are needed.

Currently, chemists are able to produce synthetic compounds in the laboratory that replace natural aromas, making the final product offered to the consumer market cheaper. In the production suggested by this pedagogical proposal, alterces roses (*Rosa Alba L.*) were used immersed in vegetable oil previously prepared from coconut (*Cocos nucifera L.*) where the extraction process took place using enfleurage in cycles of 7 days for exchange. of the petals for four weeks.



Rose Oil (Geraniol)

Source: Venâncio, A. N

b) Chemistry content: Oxygenated organic compounds derived from alcohols

To solve problems related to the production of materials, scientists have looked at organic chemistry differently, seeing opportunities for innovation in the industry sector, including pharmaceutical production. Thus, organic compounds can be understood in terms of functional groups that have different characteristics, having

carbon (C) and hydrogen (H) in their composition. In oxygenated organic compounds, in addition to carbon (C) and hydrogen (H), there is a marked presence of oxygen, a compound belonging to the chalcogen group of the periodic table. By identifying the functional group of an organic compound, it is possible to make many predictions of its likely chemical properties.

Rose essence has geraniol in its composition, which is an alcohol-function compound. Alcohols with small molecular weights are in a liquid state at room temperature, have a much lower vapor pressure and are volatile. The relatively low volatility of alcohol is a manifestation of the strength of hydrogen bonds, as well as justifying its high solubility in water. The molecular formula of alcohol is derived from water by replacing the hydrogen atom with an organic R-OH group.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, recognizing the most relevant chemical aspects in the process of formation of oxygenated organic compounds. The unity of *Earth and Universe* brings to light the importance of sustainability that permeates self-care.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT302/ EM13CNT208

g) Environmental Education content

Sustainability is a process aimed at appreciating care for oneself, others and nature from the most diverse aspects, within a historical, anthropological, economic, social, cultural, ecological perspective, in short, political education. Make use of chemical knowledge to motivate care for our body, through daily hygiene habits.

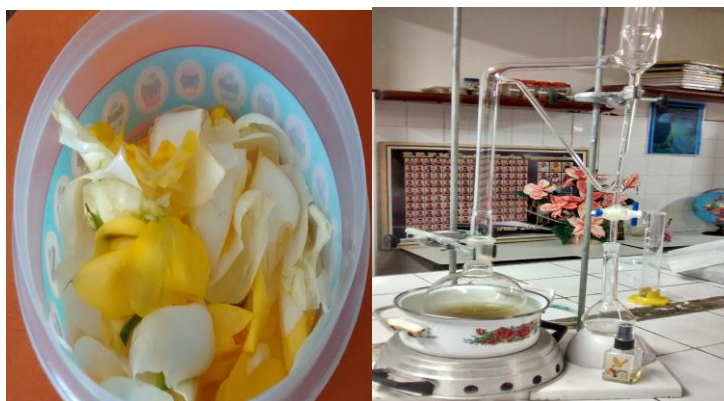
h) Objectives

Due to the importance of essential oils, this study aims to address the topic from its chemical aspects, through its development over time, as well as its importance today, impacting industry and commerce.

i) Material and methods

Materials: Roses (*Rosa Alba L.*), coconut (*Cocos nucifera L.*), essential oil distiller, 10ml beaker in 250ml, 25ml beaker, blender, distilled water, heating plate.

Method: Preparation of vegetable oil: take an average of six to eight coconuts (*Cocos nucifera L.*), blend in a blender with water until coconut milk is formed. Cook over low heat until the coconut vegetable oil forms. Let the mixture cool and then immerse the petals of 7 roses (*Rosa Alba L.*), constituting the enfleurage process based on the process of extracting the essence of the roses. This process of changing the petals is done every seven days for four weeks. Next, the distillation process is carried out to obtain the essential oil.



Source: Direct Search

j) Scheduled activities

The student will have the opportunity to understand how the process of manufacturing essential oils and vegetable oils takes place, as well as use it in the school space, making the student feel like they are protagonists of their own learning, as proposed by BNCC (2018)

k) Additional Questions

1. (ENEM) In the Middle Ages, to prepare preparations from plants that produce essential oils, species were collected at dawn. At that time, this practice was mystically based on the magical effect of lunar rays, which would be nullified by the emission of solar rays.

With the evolution of science, it has been proven that collecting some species at daybreak guarantees obtaining material with greater quantities of essential oils. The scientific explanation that justifies this practice is based on:

- a) volatilization of the substances of interest.
- b) polymerization of oils catalyzed by solar radiation.
- c) solubilization of the substances of interest by dew.
- d) oxidation of the oil by oxygen produced in photosynthesis.
- e) release of oil molecules during the photosynthesis process.

Answer: A

13. OPERATING MECHANISM OF BREATHALOMETERS

Oxygenated functions are organic compounds that contain oxygen linked to a hydrocarbon. These functions are directly linked to the production of essential oils and perfumes, and the flavor and aroma of compounds that we use in our daily lives. Thus, this pedagogical proposal aims to address the effects of alcohol at an organic level, showing the side effects arising from its intake.

The alcohol group is an oxygenated function that contains in its structure the hydroxyl group linked directly to carbon (R - OH), which is responsible for the chemical properties of these compounds. The nomenclature of such compounds, according to IUPAC, reserves the OL ending for alcohols. Alcohols can be classified according to the amount of hydroxyls into: monoalcohols, alcohols and trialcohols. The most important monoalcohols are methanol and ethanol.

a) Didactic approach

The product is obtained from the alcohol distillation process from the fermentation of sugars and cereals. Only in the fermentation of molasses does the chemical reaction occur where sucrose gives rise to glucose and fructose. The decomposition process of glucose gives rise to ethanol and carbon dioxide. The enzymes produced during the reaction are produced by the microorganism *Saccharomyces cerevisiae*. After distillation at 96°C Gay-Lussac generates the compound with 96% ethanol and 4% water. The quality of the product depends on the raw material and how it is stored.

B) From the content of Chemistry: Hydrocarbon with Oxygenated Function Alcohol.

Methanol is a one-carbon alcohol and, due to its high toxicity, its use is restricted to organic synthesis, in addition to being used as fuel. It is worth noting that methanol can cause blindness if it comes into contact with the eyes and, in cases of ingestion or inhalation, can lead to death. Ethanol or ethyl alcohol with the molecular formula $\text{CH}_3\text{CH}_2\text{OH}$ is a two-carbon alcohol and can be used as a fuel and solvent, in

addition to being obtained in the manufacture of alcoholic beverages, being the alcohol most consumed in the home. Due to the fact that ethanol causes physiological and behavioral changes when introduced into the body, it is classified as a drug. Thus, alcohol is a depressant drug that, when introduced into the body, causes physiological and behavioral changes that are reflected in the feelings, attitudes and thoughts of individuals. Thus, ethyl alcohol can develop tolerance, lead to dependence and cause withdrawal syndrome. After ingesting the drink, effects such as euphoria, disinhibition are noticed, followed by a lack of motor coordination, lack of control and sleepiness. When consumed in excess it can lead to alcoholic coma and death. As for physiological aspects, alcohol compromises the gastrointestinal tract, affecting several organs, including the liver.

Therefore, alcoholism is a serious illness that not only affects the patient, but the entire family. Alcohol, in addition to being linked to family disruption, causes material losses and emotional imbalances, being responsible for 60% of traffic accidents. One way found to reduce the excessive use of alcoholic beverages is through the use of breathalyzers in police checkpoints. The suspected driver is forced to blow into a tube connected to the breathalyzer that will indicate the degree of intoxication. The simplest type of breathalyzer contains Potassium Dichromate and a gel moistened with Sulfuric Acid, which in the presence of ethanol produces ethanoic acid, chromium sulfate, potassium sulfate and water. The color of the cartridge ranges from orange to green, depending on the level of intoxication. More modern breathalyzers are used and work based on fuel cells.

c) Area of Knowledge: Natural Sciences

d) BNCC General Competence: Natural Sciences . The *Matter and Energy* unit involves the properties of materials, recognizing the most relevant chemical aspects in the process of formation of oxygenated organic compounds. Recognize the most relevant chemical aspects in human interaction with the environment, as well as the role of chemistry in the preservation of natural resources. The unity of *Earth and Universe* brings to light the importance of sustainability that permeates self-care.

e) Year(s): 1st to 3rd Year

f) Skill(s) of the Curricular Component: EM13CNT105/ EM13CNT208

g) From the content of Environmental Education

Sustainability is a process aimed at appreciating care for oneself, others and nature from the most diverse aspects, within a historical, anthropological, economic, social, cultural, ecological perspective, in short, political education. Using chemical knowledge to motivate collective care is our mission as a society

The process of manufacturing ethanol (alcohol that has two carbons in its composition) differs in its treatment through the distillation process, giving rise to several products. Alcohol is one of the most consumed drinks in the world and is considered a depressant of the central nervous system, causing symptoms of loss of consciousness and a drop in blood pressure, also affecting the peripheral nervous system. Given this context, in today's society we can see many young people and adults using alcohol excessively, which has caused far-reaching social problems, but which often remains hidden in families with cases of alcoholism and often irreversible damage to health. .

Education's mission is to promote in young people the understanding of such chemical actions at the neural level, showing the process of dependence at the level of the nervous synapse, acting directly on the neurotransmitters, where they stop being produced by the organism, being replaced by the toxic substance introduced into the body frequently. In many cases, the alcoholic can be seen having spasms, struggling as a result of chemical dependency. In this way, we aim to raise awareness of the importance of a healthy life, reflections on love and self-care.

H) Goals

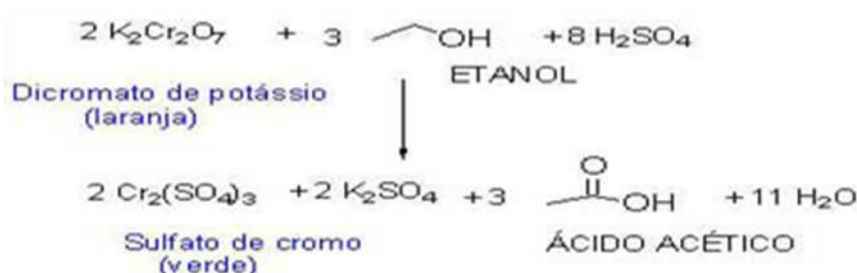
Recognizing the need to deepen the knowledge learned in the classroom, as well as providing opportunities for active reflection on everyday actions, it is proposed to understand how the process of ethanol acting on the human body works, as well as the damage caused in the short and medium term. and long term, as a way to avoid the abusive

use of this substance among young people, which ends up causing harm to society in general and mainly to the spread of diseases and even premature death.

i) Material and methods

Materials: 01 transparent glass 100 ml (small), 01 transparent glass with lid 500 ml (large), 02 latex tubes, quick-drying glue, potassium dichromate solution (50 ml at 0.1 mol/L), solution of sulfuric acid (20%) and common alcohol.

Method: As can be seen, in the large container containing $\frac{1}{4}$ alcohol inside, it must be covered and connected to two latex tubes (one must go to the bottom and the other must communicate with the small container). In the small container, it must contain the potassium dichromate solution by adding an equal volume of Sulfuric acid solution and place in the smaller glass in a total volume of 50 ml. See the figure alongside.



See more at: < <http://www.infoescola.com/curiosidades/bafometro/> >

The student will have the opportunity to observe the initial coloring of the potassium dichromate and after the blowing. You will be able to describe the reaction that happens.

j) Scheduled activities

The student will have the opportunity to understand and explain the action of alcohol on the human body, observe its effects, as well as become aware of the importance of delving deeper into the subject in question, in order to avoid organic problems, as well as traffic accidents, promoting the conservation of the space in which we live, since human beings are part of this great complex that we call nature as proposed by the PCNs and DCNEM.

g) Complementary Questions

1. (ENEM) From an environmental point of view, an important distinction made between fuels is whether or not they come from renewable sources. In the case of petroleum derivatives and sugarcane alcohol, this distinction is characterized:

A) due to the difference in the time scales of formation of the sources, geological period in the case of oil and annual in the case of sugarcane.

B) the longer or shorter time it takes to recycle the fuel used, a much longer time in the case of alcohol.

C) the longer or shorter time it takes to recycle the fuel used, a much longer time in the case of petroleum derivatives.

D) by the combustion time of the same amount of fuel, a much longer time for petroleum derivatives than for alcohol.

E) the fuel production time, as oil refining takes ten times longer than distilling sugarcane yeast.

Answer: A

2. (ENEM) Traffic accidents in Brazil are mostly caused by driver error. In most of them, the reason is the fact of driving after drinking alcohol. Ingesting a can of beer causes a concentration of approximately 0.3 g/L of alcohol in the blood. The table below shows the effects on the human body caused by alcoholic beverages depending on blood alcohol concentration levels:

Concentração de álcool no sangue (g/ℓ)	Efeitos
0,1 – 0,5	Sem influência aparente, ainda que com alterações clínicas.
0,3 – 1,2	Euforia suave, sociabilidade acentuada e queda de atenção.
0,9 – 2,5	Excitação, perda de julgamento crítico, queda da sensibilidade e das reações motoras.
1,8 – 3,0	Confusão mental e perda da coordenação motora.
2,7 – 4,0	Estupor, apatia, vômitos e desequilíbrio ao andar.
3,5 – 5,0	Coma e morte possível.

Revista Pesquisa FAPESP no 57, September 2000.

A person who has drunk three cans of beer probably has:

- A) loss of attention, sensitivity and motor reactions.
- B) apparent normality, but with clinical changes.
- C) mental confusion and lack of motor coordination.
- D) digestive dysfunction and imbalance when walking.
- E) stupor and risk of respiratory arrest.

Answer: A

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