The Chemistry of Hair and Why Representation Matters

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This curriculum unit is recommended for Integrated Science for grade 8.

Keywords: chemistry, chemical reactions, endothermic reactions, exothermic reactions, representation, biotechnology, product development, elements, careers

Teaching Standards: See Appendix1 for teaching standards addressed in this unit.

Synopsis: In 8th grade science we explore chemistry. As we dive deeper into matter and the way elements are arranged, this curriculum unit will fit in perfectly. Students learn that all of the elements on the periodic table are what make up everything in our universe. This can sometimes be difficult for students to grasp until you provide concrete examples. For this particular unit we will take a scientific approach to history. We will explore the things that people use to use in their hair from oils and other natural materials. Students will examine what elements make up the natural and synthetic products in the hair care industry. Also we will discuss what goes into developing new products. Who develops these products? What is the science behind development and who gets to be involved in the process? It is important for students to understand that underrepresentation in the sciences has been a long standing issue. We will take examples from the hair care industry but also from the medical field. This will relate to our students as they are starting to think about careers.

I plan to teach this unit during the coming year to 85 students in Integrated Science 8.

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Introduction

This curriculum unit will get to the heart of something that so many of us, including my scholars, value...hair! The hair industry has many lessons to teach as it is steeped in the study of science. Using the information provided here, teachers will be able to guide their scholars through the chemistry unit. A bonus to this is a lesson in representation in the world in certain industries. This can tie into lessons that are being taught in both Social Studies and ELA about race relations.

Rationale

The reason I am creating this unit is to connect with something relevant as it pertains to science. While we know that science shapes literally everything around us, it is hard for students to see the pertinence in many lessons we teach. This unit will give a hands-on approach to chemistry that will meet most students where they are. I will connect chemistry with the hair industry that students can relate to no matter what their background or personal situation. While our scholars get up every morning and do something to their hair (or don't), very few are aware of what they are doing from a scientific standpoint. For example, how many students shampoo their hair and think about the 50+ chemicals in each bottle (Jones and Selinger 2019). Knowledge is power and the information that is within this unit will allow students to be more informed about the choices they make with their hair every day. Also students will learn about representation in the hair industry. It is important to know who is in control of certain industries and how that affects the product outcomes. This curriculum unit is geared to help students gain the knowledge they need to make the best everyday decisions. It will also help them to understand the material and the importance of it by making it relatable to them.

School/Student Demographics: Our school is Wilson Stem Academy. We are in the Northwest Learning Community of Charlotte. This 2021-2022 school year will only be our 4th year open since being closed for several years. We are a Title I school. Our district provides free breakfast and lunch for every student. Most students attend Wilson as their zone school and take the bus to get here every day.

Wilson is a S.T.E.M. school that incorporates technology in several ways even before the virtual atmosphere. Our scholars have several options for Project Lead the Way elective classes. They range from App Designing to Computer Science to Flight and Space courses. We are 1 to1 with technology, as all students were provided with new Chromebooks at the beginning of the year. Our school also has a magnet component that allows students that are not zoned to attend Wilson to apply to participate in some of our Science and Technology courses.

Our current enrollment for this school year is 444 students. 318 are African American, 90 are Hispanic, 10 are white, 18 are Asian, 7 are two or more races and 1 student identifies as American Indian. Our school is split at 223 females and 221 males in attendance. We have 51 English learning students and 57 students with disabilities. We also have 33 McKinney-Vento

students; these are students who are housing insecure. Our enrollment has decreased about 10% since last year.

I teach 8th grade Integrated Science. Every scholar takes this science course as a part of their core curriculum. Some of the curriculum in science is introduced in the 6th grade. This gives some students a foundation for the information that we teach. I have four classes that include one honors and one ESL focused class. The class is a yearlong course and it includes an EOG test in May. Many of my students are thinking of taking a vocational approach to post-secondary education. For some this includes doing hair or becoming barbers. This unit will give some scholars a deeper look into those careers and the industry behind them. For others it will allow them to think about careers they may have never heard of but may be interested in.

Unit Goals

The goals for this unit are to have students be able to master each standard listed in Appendix 1. By completing the specific activities and vocabulary for the curriculum students will also be able to ascertain information about the elements that are the building blocks for life: Oxygen, Carbon, Hydrogen, and even sometimes Nitrogen. Once these foundations are established, scholars can link this knowledge into second tier learning to explore and understand chemistry and how chemistry affects many parts of our everyday lives. The goal for the unit is to tie the information into how students use chemicals responsibly.

I would also like for students to use this information to start considering the role that science plays in careers they are considering. Scholars that are directly interested in cosmetology can make connections between this career and how science can help their clients. It is also important that all students be able to understand why being a part of the science world can benefit them and their communities. Representation of all peoples is essential and through this curriculum unit, students should be able to see the consequences of some people not being included in the discussion of different industries.

The end goal is for students to be able to use this one main idea to see how all branches of science are dependent on one another. Using one string to tie together chemistry, biology and even a little physical science, will allow students to retain the knowledge better to master the content and be successful on the EOG. Chemistry is one of the largest sections on the EOG. It is also one of the most challenging for many of my scholars. By teaching the relevant standards in a more engaging and relevant way it is my hope that students will remember the information for the end of grade test as well as for the rest of their lives.

Content Research

Chemistry Overview

To set up this curriculum unit it is necessary to introduce the chemistry unit. Atoms are the basis of all things. (Why should you never trust an atom? They make up everything!) The periodic table contains 118 elements that all consist of atoms of one particular thing. For example, element 16, Sulfur consists of only Sulfur atoms. Compounds are combinations of two or more elements and are the result of chemical bonds. For example, table salt is made up of sodium and chlorine to make Sodium Chloride (NaCl). Mixtures are a non-chemical combination of elements or compounds. For example, air is a mixture of nitrogen, oxygen, small amounts of water vapor, carbon dioxide, and small amounts of other gases. Mixtures, as many hair care products are, often include water. Water is the universal solvent and many things dissolve in water making it a common base in many products.

Elements are arranged on the periodic table based on their properties, both chemical and physical. Individual elements have properties that may be different from those they exhibit when combined with other elements. One example of this is Sodium (Na) and Chlorine (Cl). Sodium is an alkali earth metal while Chlorine is a lethal halogen/non-metal. When they combine chemically to make NaCl they form salt, a compound that has completely different properties than both. Most elements up to number 92 are naturally occurring with the exception of Technetium and Promethium, which are made in labs. (Boudreaux)

Chemical reactions happen as a part of our daily lives. Students will learn that something as simple as driving a car or cleaning their homes is a result of a chemical reaction. The law of conservation of mass states that all products and reactants must equal in a reaction. Mass can be transferred but not destroyed. This means that nothing is created and nothing is destroyed in any given chemical reaction. This is important to reiterate as many scholars struggle with the idea of everything in the world being recycled. Chemical reactions can also almost never be undone. For example, combining ingredients to bake a cake. This becomes especially important to know once the students begin to understand the chemicals they add to their own hair and the damage that can be done.

Hair Care History

Hair care products have generally been created to help clean and protect hair from things like the weather. Different hair reacts differently to humidity, changes in temperature, being wet from rain, being dried out by the sun, dust and other particles in the air, and some artificially maintained environments like air conditioning in the modern era. People have used hair care products in many ways. Some products straighten hair, some curly hair; some are meant to grow hair, some are meant to remove hair; some are meant to protect hair from damage, while others may inadvertently cause damage to hair in order to fulfil their purposes. Hair products come in a variety of types including sprays, cream, foams, powders, liquids, oils, spritzes, etc.. Products can be used to help people enhance their natural hair (ex. Vitamins and natural oils like coconut oil are said to help enrich your natural hair) or help them change their natural hair into something different (Ex. hair color and relaxers help change hair, either temporarily or permanently, into something else).

Chemicals were not always a part of hair care. "To maintain natural hair growth and the strength of their hair, Egyptians were pioneers in using castor oil"(Arab News). In the beginning, the focus of hair was on taking natural tresses and keeping them healthy and moisturized. Interestingly enough, using ingredients that are used even still today. But Egyptians were more than innovators in hair health. Fashion was definitely a priority for them as well. "The wearing of wigs dates from the earliest recorded times; it is known, for example, that the ancient Egyptians shaved their heads and wore wigs to protect themselves from the sun…"(Britannica). As in most styles, the wealthy set the trend for how society would come to view fashion standards. Just as today, we look to celebrities for new hair trends. Beauty has come 360 degrees from what people did in ancient times. People are back to using natural ingredients and using hair extensions as protective styles.

Artificial hair was a staple in Ancient Egyptian royalty. People wore wigs and extensions for everyday use and for special occasions such as funerals. They were for style but also for the practicality of cleanliness (Fletcher). Fletcher goes on to state that hair extensions can be traced back to as early as 3400 BC. The difference between today and Ancient Egypt was that they primarily used human hair. When wigs were revived in Roman times, things like date palm fiber and grass were used to supplement wigs and hairpieces (Fletcher). The 16th century saw a resurgence of wig popularity.

> "It was not until the 16th century, however, that the wig again became a generally acceptable form of adornment or corrective for nature's defects, as in the case of Queen Elizabeth I. Men's perukes, or periwigs, for the first time since ancient Egypt, came into widespread use in the 17th century, after Louis XIII began wearing one in 1624. By 1665 the wig industry was established in France by the formation of a wigmakers guild." (Britannica)

During the early 1900s, Sarah Breedlove, the first non-slave person of her family, developed a multi-million dollar hair business, inspired by her own hair loss due to hair disease. (Madame C.J. Walker) She would later be known as Madame C.J. Walker. At the same time, according to Biography.com, Garett Morgan, a black man, accidentally discovered a hair straightener while working to alleviate sewing machine issues. (Biography.com) He initially tested this product on the fur of a curly hair dog belonging to his neighbor, then he tested the product on himself. (Biography.com) It was an instant hit marketed to African Americans to relax the kinks in the hair. (Biography.com)

In modern day, the hair industry unfortunately does not seem to be much regulated. According to one BBC article by Kirstie Brewer, hair is often labeled incorrectly in regards to where it comes from and how it is processed. Researcher Emma Tarlo says, people do not really ask questions. They do not want to think about the person whose hair they are wearing and where they are from or what they went through to give up the hair. The BBC article recounts how hair peddlers come around and buy old hair out of combs for around a dollar per mound. With this in mind it is no wonder that some women suffer negative reactions to hair that they have paid hundreds of dollars for. To make the hair more suitable it is then put into a chemical

bath (Brewer). This could further add to the irritation that some men and women have experienced when adding extensions made from this questionably sourced hair.

Some of the negative reactions that people may face when using hair products, specifically chemical hair relaxers include frizzy hair, hair discoloration (especially graying hair, although other colors are possible), dandruff, hair loss, split ends, thinning, weakening, breaking hair, and potential long term effects (Shetty). Some negative reactions do not only apply to and affect those that are getting their hair done but negative reactions apply to the hair professionals doing the hair and providing the services, as they complain of health complications due to the work they do and products they are exposed to. (Wilcox) However, The National Center for Biotechnology Information found out that there are many reasons people were, and still are, willing to take the risks of these negative reactions. While beatification was the most important reason for using chemical relaxers, other reasons include ease of management, social acceptability, and peer pressure. (Shetty)

Despite negative reactions and experiences that people may face using hair products like hair relaxers it is not surprising that people would put issues like social acceptability and peer pressure above the negative considerations. "In May 2017, a 16-year-old high school student in Florida was told that her natural hair violated the school's dress code, which requires that hair is "neat" and clean."(Wilcox) In 2016, the 11th Circuit Court of Appeals, in a 3-0 decision, "ruled that banning an employee from wearing their hair in locs is not racial discrimination". (Scott) These instances and cases, and many others, show why hair products like chemical relaxers, with all their potential problems, are not only still used but still are a big part of the hair care industry, especially for minorities.

Chemistry of Hair Care

Some women turn to synthetic hair as an alternative. In general artificial hair extensions have been cheaper and are often used for more short term styles. Synthetic hair like human hair is a polymer. It is composed of fine plastic fibers, manufactured to look like human hair (Whitehurst). A polymer is:

> "...a large molecule made up of chains or rings of linked repeating subunits, which are called monomers. Polymers usually have high melting and boiling points. Because the molecules consist of many monomers, polymers tend to have high molecular masses...Polymers may be divided into two categories. Natural polymers (also called biopolymers) include silk, rubber, cellulose, wool, amber, keratin, collagen, starch, DNA, and shellac...Synthetic polymers are prepared by a chemical reaction, often in a lab. Examples of synthetic polymers include PVC (polyvinyl chloride), polystyrene, synthetic rubber, silicone, polyethylene, neoprene, and nylon. Synthetic polymers are used to make plastics, adhesives, paints, mechanical parts, and many common objects." (Helmenstine)

Some of those polymers end up in our hair! Either naturally, because natural hair is made of keratin or synthetically. Synthetic hair is made of nylon, or polyester. It can be marketed under such names as Kanekelon and can be made out of acrylic. So some of the hair we wear is made

of the same material as artificial nails. Acrylic like most things is made from the basic elements of carbon, hydrogen, and oxygen.

"Proline, the manufacturers of Dark and Lovely, manufactured the first official lye relaxer, which consisted of sodium hydroxide, water, petroleum jelly, mineral oil and emulsifiers. The lye straightened hair by weakening the internal protein structures of the hair, loosening the natural curls"(Richard). Since hair is made of keratin, lye relaxers break down the protein and over time can weaken the hair.

Considering what lye can do to hair it is no wonder what it can do to skin. Lye relaxer's primary ingredient is Sodium Hydroxide. NaOH or sodium hydroxide is very corrosive. Corrosive things can eat through a number of different things including skin. It can also be used for "bleaching, metal cleaning and processing, oxide coating, electroplating, and electrolytic extracting. It is commonly present in commercial drain and oven cleaners." ("Sodium hydroxide | NaOH", n.d.) People have been known to have serious chemical burns and hair loss after using the lye relaxer. It stands to reason since lye has some very serious implications when it comes to hazardous materials.

The 1970's saw a change in the relaxer industry. After realizing the damage that lye relaxers were causing consumer's hair, the manufacturers created a no-lye relaxer (Richard). The results were potassium hydroxide and lithium hydroxide instead of sodium hydroxide. Some sources also state that a calcium hydroxide relaxer. While no-lye relaxer is known for being milder on hair, it is not without its own troubles. No-lye relaxers are known for causing hair dryness. The chemical reaction that happens once the relaxer is mixed causes calcium build up to block the moisture absorption of the hair.("Hair Question: Lye vs. No Lye Relaxer - The Difference + Pros and Cons" 2017) As with anything most certified hair experts know how to combat the issues of both a lye or no lye relaxer. However, most salons only use lye relaxers.

Representation and Why It Matters

"African-Americans spend $1.2 trillion each year, and that number is projected to rise to $1.5 trillion by 2021. In 2018 the Black hair care industry raked in an estimated $2.51 billion.."(Holmes) The question that remains is who does this money profits. We know that in recent years more products have come on the market that benefit people of color. These products are tailored to the hair patterns of black and brown women in a way that they never have been before. But who is really controlling the industry's finances? When we go to a beauty supply store, are the people that are selling the supplies the same type of people buying the supplies? Without representation in certain industries, there will always be some inequities.

Going back to Samuel Morton and his scientific racism reminds us that it was not very long ago that science was used to systematically divide and oppress people (Kolbert). When only one type of people are controlling the narrative in any situation, others may suffer. This was the case for years in the beauty industry. With the exception of a few notable entrepreneurs, the hair industry has been controlled by people that looked very different from the consumers. The hair

industry is not the only industry in which lack of inclusion is evident. Many stem careers fall into this category.

"The sociology of science tends to converge on accuracy when different biases or errors cancel each other out, but this is less likely to happen when lack of diversity leads to correlated error"(Medin and Lee). When the minds that are converging on an issue are able to lend their experiences and background to the issue, we get more ideas to choose from. When medical studies are not including a diverse sample of people the results may not hold true for the entire population. Treatments may not help those of all backgrounds. This was the case for years in the hair care industry. Products were made that were touted to be for all hair types, when in fact that meant hair types for one or two groups of people.

The only way for there to be more inclusivity in the sciences is for more people of color to enter the sciences. There should be people of all types in every different field. In evolution we know that diversity is what makes species better able to survive. In this same vein, diversity will help our industries to thrive.

Instructional Implementation

Teaching Strategies

Vocabulary

Students will always begin a new unit with vocabulary. This helps them to have a strong foundation of understanding the unfamiliar information that they are receiving. For this unit in particular, some words are familiar but not in the context that students are used to. To introduce vocabulary, Quizlet is used. This helps for students that have IEP goals and those that are English Language Learners. The program allows students to input words and select from 3 different correct definitions. They can decide which definition makes the most sense to them. In addition, scholars add an image to their word to make it additionally sticky to their memories. I incorporate the game of Quizlet live as a way to assess and as a way for students to study the material. As I check the material I am able to see if there are any students that did not fully grasp the meaning of the terms.

Project-Based Learning

In this curriculum unit, scholars will have an end project in mind. Through the project, geared at understanding the importance of inclusivity, students will gain an ability to work as a team

towards a common goal. The hands-on aspect of completing the project will stimulate engagement as well as stretch their thinking to the limits. In project based learning for this particular project, teachers have to be mindful of matching students based on differing abilities and learning/thinking styles. Students need a variety of mentalities to make this project work well. Project based learning is also a way to differentiate for learners of differing abilities. Those that may not necessarily fare well on traditional tests, have the opportunity to display their knowledge in a different way.

WICOR

A well-known AVID strategy known as WICOR is key in implementing the lesson plans. Students will need to write about their opinions on matters of representation. Writing is also a great strategy when you are asking students to present their ideas. This tool gives them an opportunity to collect their thoughts, which in turn makes them more confident in their presentations. Inquiry will be used in the project as well as throughout the lesson as they ask questions surrounding what they have learned and still do not understand. The inquiry feature will give the students an occasion to explore topics that they may be interested in but unsure about. Collaboration that will be used in the group project at the end. Students will be researching information to support their project. This will add to the reading component as they will need to sift through many different sources to find information relevant to their particular project.

Experiments/Labs

Hands-on experiments will be an important part of this curriculum. We will use hands-on activities to demonstrate how chemicals can affect our bodies. Demonstrations involving chemical relaxers will allow students to see firsthand some things that they may never have experienced before.

Classroom Discussion

Hair is a very personal thing for many people, including those in our classrooms. Classroom discussion should be encouraged so that students can share their experiences with one another. This works especially well if you have a diverse group of students, but we all have very different hair journeys regardless. Some believe natural hair is the way to go. Some have perms, some have relaxers, and some have locs. Allowing students to have healthy and respectful discourse will go a long way in creating the culture of understanding that we all strive for.

Classroom Lessons/Activities

Lesson One: Chemistry Intro

Learning Objective: Students will be able to demonstrate understanding of chemistry vocabulary by using Quizlet to create a live game and score 80% accuracy or above.

Materials: Chromebooks, Vocabulary Sheet(see Appendix 2)

Introduction/Warm-Up: Introduce the idea of chemistry with this Tidlybit video. What are Atoms? The smallest parts of Elements and YOU!

Explicit Instruction: To start off with, go through the list of words on the vocabulary sheet to ensure proper understanding and pronunciation. Give students the following instructions on how to create Quizlet flashcards if you have not previously used them in your classroom. Model the first two or three words to ensure understanding.

1. Go to Quizlet.com (not Quizlet live)
2. Login with your google student account
3. Click the blue create button on the top and select study set
4. Title your study set vocabulary Chemistry Intro Vocab
5. Add your vocabulary word next to the number 1 and select the best definition for you
6. Add a picture by clicking on the image button on the right
7. Move to the second line and repeat steps 5 and 6
8. You may need to click the add a card button at the bottom to have room for all 20 words
9. When all 20 words are complete click the blue create button at the bottom
10. You can share or edit your set at any time, it will stay in your Quizlet account until deleted

Individual Practice: Have students complete all 20 Quizlet words.

Assessment: Select a student that you believe has done an exceptional job and use their link for Quizlet Live. Allow all students to login to the game and see how many have met the objective of 80% mastery or higher.

Lesson Two: Chemical Reactions

Learning Objective: Students will be able to identify chemical reactions and explain at least 3 indicators of a chemical reaction

Materials: Eggs, Lye relaxer, hair samples from different races if possible (natural, artificial, relaxed, curly) lighters, safety goggles, safety gloves

Introduction: Chemical reactions take place when two or more chemicals are combined and a new compound is formed. Ask students to think of 2 things they think will classify as a chemical reaction based on the definition.

Explicit Instruction: Use the lab sheet (see Appendix 2) to instruct students through the experiment of adding lye relaxer to their egg and burning different hair samples. Have students fill in the lab sheet.

Explanations for the Lab: 1. Students will take an egg and slather each egg with lye relaxer. Students will check on their egg at different intervals to see if they notice any damage to the egg. 2.Have students bring hair from a comb or brush from home. They will use different samples of each other's hair to complete the experiment. All students will wear gloves for safety and sanitation. Students will use an aluminum pan and slowly burn different samples of the hair. They will make observations after each experiment and note it on their lab sheet. Explain to students that adding the heat to the hair simulates what we do to our hair on a regular basis as it pertains to styling and drying.

Individual Practice: Have students complete an Edpuzzle that gives them information on the other indicators of chemical reaction. See appendix 2.

Assessment: Use the chemical reaction Edpuzzle in Appendix 2 as an exit ticket to ascertain whether or not the students grasp the idea of chemical reactions.

Lesson Three: Representation in the Sciences

Learning Objective: Students will be able to identify instances of underrepresentation in the sciences and connect the idea to an instance in their everyday life

Materials: Articles from Appendix 2 on representation ("There's No Scientific Basis for Race—It's a Made-Up Label" & "Diversity Makes Better Science"), CER Starter Sheet from Appendix 2

Introduction: The class will read through the articles on representation in science and race ("There's No Scientific Basis for Race—It's a Made-Up Label" & "Diversity Makes Better Science"). Allow students to ask questions to gain understanding of ideas they do not comprehend.

Article 1 ("There's No Scientific Basis for Race—It's a Made-Up Label"): (Found in Appendix 2) This article sets the class up to understand the history of scientific racism.

Explicit Instruction: After reading the article, help students make connections to race relation studies they have gone through in social studies. Ask probing questions about how Samuel Morton's findings could have changed the way minorities were treated one way or the other. Have students write down their views of Samuel Morton's findings. Afterward, instruct students to think about and share with a partner or out loud if they think that similar thinking continues in modern day times. If there is similar thinking today, what forms do they take? Do they occur the same way as in previous times?

Repeat the same with Article 2 ("Diversity Makes Better Science"-found in Appendix 2). Do students agree or disagree? Why?

Individual Practice: Students will use the articles ("There's No Scientific Basis for Race—It's a Made-Up Label" & "Diversity Makes Better Science") to make a claim about how they think

marginalized groups of people are affected by underrepresentation in different industries. See CER starter sheet in Appendix 2.

Assessment: Informal assessment by exit ticket question: Do you agree or disagree that representation is still an issue today?

Lesson Four- STEM Business Model

Learning Objective: Students will be able to create a mini-business model of a business of their choice and identify the underrepresentation problems that may arise. Students will be able to answer questions regarding their business model from the class.

Materials: Poster board, Chromebooks, Coloring materials, Google slides

Explicit Instruction: In groups of two or three, have students create a S.T.E.M business model for a company they would want to run. Give students a rundown of things they will need to consider. Demonstrate using a company they already are familiar with. For example, a hair salon. Tell students they need to consider the following: What days they will be open, staffing levels, hiring procedures; do you need to get products from somewhere else and if so where products they will sell; How and where they will sell their products; and how much money they will sell each item for? When all businesses are created you will hand out the Worksheet 3 from Appendix 2. These are the questions that the class will ask in regards to the inclusivity or lack thereof in their business.

Individual Practice: Groups will take 30-45 minutes to create a “business model”. Students will then defend their business model against the “surprise” list of inclusivity questions.

Assessment: A debrief will be on the bottom of the question worksheet found in Appendix 2 that asks students to explore if they considered all people when creating their business model. Use this debrief to assess whether students understood the importance of representation in business.

Appendix 1: Implementing Teaching Standards
Standards Relevance

8.P.1 Understand the properties of matter and changes that occur when matter interacts in an open and closed container.

8.P.1.1 Classify matter as elements, compounds, or mixtures based on how the atoms are packed together in arrangements.

Curriculum Unit Relevance: The unit reinforces the learning of key vocabulary and information that supports P.1.1. Students will use included activities to tie keywords like elements, compounds, and mixture into real world examples.

8.P.1.2 Explain how the physical properties of elements and their reactivity have been used to produce the current model of the Periodic Table of elements.

Curriculum Unit Relevance: Students will be able to take the information learned about real products and identify elements from the Periodic Table of Elements.

8.P.1.3 Compare physical changes such as size, shape and state to chemical changes that are the result of a chemical reaction to include changes in temperature, color, formation of a gas or precipitate.

Curriculum Unit Relevance: Students will use experiments on hair and hair products to get hands-on understanding of how chemical changes occur. Also they will be able to determine how they can confirm the difference between a chemical and physical change.

8.P.1.4 Explain how the idea of atoms and a balanced chemical equation support the law of conservation of mass.

Curriculum Unit Relevance: Students will review the definition of law of conservation of mass and use combustion experiments to reinforce the information they have learned.

Appendix 2: Documents for Lessons

Vocabulary List for Lesson One

1. Elements
2. Atoms
3. Molecules
4. Matter
5. Compounds
6. Mixtures
7. Physical Properties
8. Chemical Properties
9. Physical Changes
10. Chemical Equation
11. Chemical Reaction
12. Acid
13. Base/Alkaline
14. Law of Conservation of Matter/Mass

15.Chemical Bond
16.Protons
17.Neutrons
18.Electrons
19.Combustion
20.Density

Lab Sheet for Lesson Two

Materials:

Questions to be answered:

1. What will happen when the relaxer is applied to the egg?
2. What will happen when different hair samples are burned?

Hypotheses (What do you think will happen?)

1.
2.

Experiment Procedures (What did you actually do?)

1.
2.

Collect Data (What actually happened?)

1.
2.

Conclusion (Were you correct with your hypotheses?)

Edpuzzle for Lesson Two
https://edpuzzle.com/media/61996fa478879c4180da36bb

Article One for Lesson Three

There's No Scientific Basis for Race—It's a Made-Up Label

It's been used to define and separate people for millennia. But the concept of race is not grounded in genetics.

BY ELIZABETH KOLBERT

PHOTOGRAPHS BY ROBIN HAMMOND
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Skulls from the collection of Samuel Morton, the father of scientific racism, illustrate his classification of people into five races—which arose, he claimed, from separate acts of creation. From left to right: a black woman and a white man, both American; an indigenous man from Mexico; a Chinese woman; and a Malaysian man.

PHOTOGRAPH BY **ROBERT CLARK**

In the first half of the 19th century, one of America's most prominent scientists was a doctor named Samuel Morton. Morton lived in Philadelphia, and he collected skulls.

He wasn't choosy about his suppliers. He accepted skulls scavenged from battlefields and snatched from catacombs. One of his most famous craniums belonged to an Irishman who'd been sent as a convict to Tasmania (and ultimately hanged for killing and eating other convicts). With each skull Morton performed the same procedure: he stuffed it with pepper seeds—later he switched to lead shot—which he then decanted to ascertain the volume of the braincase.

Morton believed that people could be divided into five races and that these represented separate acts of creation. The races had distinct characters, which corresponded to their place in a divinely determined hierarchy. Morton's 'craniometry' showed, he claimed, that whites, or 'Caucasians', were the most intelligent of the races. East Asians—Morton used the term 'Mongolian'—though 'ingenious' and "susceptible of cultivation," were one

step down. Next came Southeast Asians, followed by Native Americans. Blacks, or 'Ethiopians', were at the bottom. In the decades before the Civil War, Morton's ideas were quickly taken up by the defenders of slavery.

This story is part of a series about racial, ethnic, and religious groups and their changing roles in 21st-century life. The series runs through 2018 and will include coverage of Muslims, Latinos, Asian Americans, and Native Americans.

"He had a lot of influence, particularly in the South," says Paul Wolff Mitchell, an anthropologist at the University of Pennsylvania who is showing me the skull collection, now housed at the Penn Museum. We're standing over the braincase of a particularly large-headed Dutchman who helped inflate Morton's estimate of Caucasian capacities. When Morton died, in 1851, the *Charleston Medical Journal* in South Carolina praised him for "giving to the negro his true position as an inferior race."

Today Morton is known as the father of scientific racism. So many of the horrors of the past few centuries can be traced to the idea that one race is inferior to another that a tour of his collection is a haunting experience. To an uncomfortable degree we still live with Morton's legacy: racial distinctions continue to shape our politics, our neighbourhoods, and our sense of self.

This is the case even though what science actually has to tell us about race is just the opposite of what Morton contended.

The DNA profiles of these two are nearly 99 percent the same. The genes of any two humans, of course, are even more alike. But after our prehuman ancestors shed most of their body hair, we evolved highly visible differences in skin colour. Tiny tweaks to our DNA account for them. Dark pigmentation would have helped our ancestors cope with the intense African sun; when humans migrated out of Africa into low-sunlight regions, lighter skin became advantageous. PHOTOGRAPH BY **CARY WOLINSKY, NATIONAL GEOGRAPHIC CREATIVE (CHIMPANZEE); ROBIN HAMMOND (BABY)**

Morton thought he'd identified immutable and inherited differences among people, but at the time he was working—shortly before Charles Darwin put forth his theory of evolution and long before the discovery of DNA—scientists had no idea how traits were passed on. Researchers who have since looked at people at the genetic level now say that the whole category of race is misconceived. Indeed, when scientists set out to assemble the first complete human genome, which was a composite of several individuals, they deliberately gathered samples from people who self-identified as members of different races. In June 2000, when the results were announced at a White House ceremony, Craig Venter, a pioneer of DNA sequencing, observed, "The concept of race has no genetic or scientific basis."

Article Two for Lesson Three

PRESIDENTIAL COLUMN

Diversity Makes Better Science

April 27, 2012

TAGS:

- APS PRESIDENT
- DIVERSITY
- DOUGLAS MEDIN COLUMNS
- EDUCATION
- ETHNICITY
- GENDER
- HISTORY OF PSYCHOLOGY
- INTERGROUP RELATIONS
- RACE RELATIONS

I'm honored to co-author this column with my colleague and friend Carol Lee. Among Carol's many honors is having been President of the American Educational Research

Association (AERA). – DLM

Douglas L. Medin

It's not news that minorities are severely underrepresented in both science and science education. Efforts to increase diversity typically fall into two broad classes: some motivated by a concern for equity and social justice, and others motivated by a concern for increasing the pool of scientists that are prepared to address contemporary needs in science and technology. Our purpose in this column is to draw attention to another compelling rationale for increasing diversity in the sciences, a rationale that is intrinsic to the process of scientific inquiry and to the effectiveness of science education. We start from an expansive conception of science that includes not only the biological, physical, social, and psychological sciences, but also the practices within these disciplines, the ecological validity of their research programs, and the manner in which novices — especially K-12 students — learn these disciplines.

Carol D. Lee

Our point is that attention to cultural membership and cultural practices is central to equity goals and national needs, but also equally important for the construction

of knowledge and for the enterprise of science itself. Moreover, we cannot and do not shed our cultural practices at the door when we enter the domain of science, science education, or science learning.

Before defending this claim, we need to clarify that we do not subscribe to a “box model” of diversity in which gender or ethnicity are essentialized or reduced to a list of internal traits. Instead, we focus on the diversity of life practices, perspectives, values, and motivations that are often correlated with these groupings (Gutierrez & Rogoff, 2003).

Validity in the sciences involves much more than attending to canons about the need for proper controls, replicability, and the like. It involves choices about what problems to study, what populations to study, and what procedures and measures should be used. In making these choices, diverse perspectives and values are important. Consider the strong correlation between social-science researchers and the people they study. This predominantly White middle-class group of scientists focuses their research programs primarily on White, middle-class populations. This reliance on “convenience samples” (using undergraduates from introductory psychology courses is the paradigmatic example) does not stem from purposeful neglect of other potential samples. Nonetheless, it has disadvantageous consequences, including the fact that results based on this narrow slice of humankind may not, and often do not, generalize to other populations (Henrich, Heine, & Norenzayan, 2010).

Diverse perspectives and values also affect a researcher’s choice of methods. Consider, for example, wildlife biologist Flo Gardipee, who studies population structure and gene flow in North American bison. Her First Nations perspective (she is Cherokee and Irish) led her to seek non-invasive methods for sampling buffalo DNA. She has pioneered the practice of using fecal samples for DNA collection (Gardipee et al., 2007). This method allows the widespread sampling of free-ranging bison populations with minimal human interference to their behavior and activities.

Diverse perspectives often are associated with diverse research foci and the generation of new findings. For example, when female scientists began to study

primate social behavior, new insights into both female and male behaviors were uncovered (Hrdy, 1986).

In various fields of psychological science, minority scholars and culturally oriented majority scholars have expanded previously accepted conceptions of identity development, motivation, and resilience (Graham & Hudley, 2005; Spencer, 2006). For example, broadly accepted theories arguing for the primacy of an internal locus of control have been contested, pointing to the efficacy of an external locus of control when populations face persistent stigmatization that they do not control (Crocker & Major, 1989). Research on the role and complexity of racial socialization has pushed boundaries around accepted conceptions of identity development (Bowman & Howard, 1985; Boykin & Toms, 1985).

On a more abstract level, there are formal proofs that diversity of orientations can even trump ability in problem solving. For example, Scott Page (2007) has documented how the presence of diverse perspectives (including gender and ethnic diversity) in collective problem-solving in business and other organizations leads to more innovative solutions. Even when the focus is on the same topics with the same methods and measures, diversity may help. The sociology of science tends to converge on accuracy when different biases or errors cancel each other out, but this is less likely to happen when lack of diversity leads to correlated error.

Another warrant for consideration is evidence of the fundamental role of culture in human learning, suggesting that there is no reason to think learning in science or the practices of science is somehow acultural or simplistically universal. Current developmental research in both cultural psychology, as well as cultural and social neuroscience, underscores the fact that human development is an outgrowth of dynamic relations between our biological endowments and the shaping role of our environment. Indeed, developments in the fields of cultural and social neuroscience provide a window into how human learning is an outgrowth of the threading of biological and environmental (i.e., cultural) resources, from the levels of epigenetic change to broader life-course trajectories (Quartz & Sejnowski, 2002).

CER Starter Sheet for Lesson Three

Claim:

I believe/do not believe that the _____industry still suffers from underrepresentation.

Evidence-Use the articles provided or others you find to cite specific examples that support your claim.

_____
_____
_____
_____
_____
_____

Reasoning-This combines your evidence and your claim. How does the evidence support your claim?

_____
_____
_____
_____
_____
_____
_____
_____
_____

Worksheet 3: Questions and Debrief for Lesson Four

Which holidays does your business close for? Why?
What are your company's maternity/paternity policies?
Do you have age restrictions for your employees? Minimum? Maximum?
What accommodations will you include for people with disabilities? (Keep in mind disabilities can be physical
mental.)
Who is hiring at your company? Do they enter with any biases?

Debrief: Did the questions that your classmates asked expose any underrepresentation or discrimination in your business? How so?

_____
_____
_____
_____
_____
_____

List of Materials for Classroom Use

1. Chromebooks - used to access relevant websites (ex. Quizlet.com) and applications (ex. Google slides) for the lessons
2. Vocabulary Sheet- (see Appendix 2) used in lesson 1 and to increase knowledge
3. Eggs- used in lesson two on chemical reactions
4. Lye relaxer- used in lesson two on chemical reactions
5. Hair samples from different races if possible (natural, artificial, relaxed, curly)- used in lesson 2 on chemical reactions
6. Lighters- used in lesson two on chemical reactions
7. Safety goggles- used in lesson two on chemical reactions for safety
8. Safety gloves-used in lesson two on chemical reactions for safety
9. "There's No Scientific Basis for Race—It's a Made-Up Label"- (see Appendix 2) article used in lesson three on Representation in Science
10. "Diversity Makes Better Science"- (see Appendix 2) article used in lesson three on Representation in Science
11. CER Starter Sheet -(see Appendix 2) used in lesson three on Representation in Science

12. Poster board- can be used by students in lesson 4 on mini-businesses to display business models
13. Coloring materials-can be used in lesson 4 on mini-businesses to create business models
14. Worksheet 3- to be used in lesson 4 on mini-businesses to debrief

Resources for Students

Arab News. “The Secret of Ancient Egyptian Beauty.” *Arab News*, Arabnews, 25 Dec. 2012, www.arabnews.com/secret-ancient-egyptian-beauty.

This source gives a history of Egyptian hair and beauty routines and norms. It speaks about the time frame and the things that were important to Egyptian men and women.

Biography.com Editors. “Garrett Morgan.” *Biography.com*, A&E Networks Television, 3 June 2021, www.biography.com/inventor/garrett-morgan.

This source gives information about inventor Garrett Morgan. It explains his contributions to the hair care industry but also several other inventions he became well known for.

Boudreaux, Kevin A. “Naturally-Occurring and Synthetic Elements.” *Angelo.edu*, www.angelo.edu/faculty/kboudrea/periodic/physical_natural.htm.

This source gives information on elements of the Periodic Table. It gives background on those that are naturally occurring and those that are not.

Brewer, Kirstie. “Untangling Where Your Hair Extensions Really Come From.” *BBC News*, BBC, 1 Nov. 2016, www.bbc.com/news/magazine-37781147.

This source gives information about where human hair is sourced from. It gives information about the Asian hair industry.

Britannica, T. Editors of Encyclopaedia. “Wig.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., www.britannica.com/topic/wig.

This source is a brief description of the history of wigs.

“Chemistry.” *ThoughtCo*, www.thoughtco.com/chemistry-4133594.

This is a source that gives basic background information on Chemistry.

Clark, Photograph by Robert, and Photograph by CARY WOLINSKY. “There's No Scientific Basis for Race-It's a Made-up Label.” *National Geographic*, 4 Apr. 2018, www.nationalgeographic.co.uk/people-and-culture/2018/04/theres-no-scientific-basis-race-its-made-label.

This National Geographic article gives background information on scientific racism. It also speaks about some of the implications of Morton’s work.

Ducksters. Accessed November 21, 2021. https://www.ducksters.com/.

A general science resource for students and teachers.

Jones, Dr. Oliver, and Ben Selinger. “The Chemistry of Cosmetics.” *Science.org.au*, 19 Sept. 2019, www.science.org.au/curious/people-medicine/chemistry-cosmetics.

This article gives an overview of the chemistry of the cosmetics industry. It does also touch on personal care products that include: deodorant, soap and shampoo.

Medin , Douglas L., and Carol D. Lee. “Diversity Makes Better Science.” *Association for Psychological Science - APS*, Association for Psychological Science - APS, 27 Apr. 2012, www.psychologicalscience.org/observer/diversity-makes-better-science.

This article is a look at the lack of inclusivity in the science community. It gives information as to how more diversity can actually make the field better.

Richard, Cicely A. “The History of Hair Relaxers.” *Classroom*, 30 June 2020, classroom.synonym.com/the-history-of-hair-relaxers-12078983.html.

This source is a brief history of hair relaxers from invention to the no-lye era.

“Sodium Hydroxide.” *National Center for Biotechnology Information. PubChem Compound Database*, U.S. National Library of Medicine, pubchem.ncbi.nlm.nih.gov/compound/Sodium-hydroxide.

This source gives information about Sodium Hydroxide. There are many chemical compound informational pages on this site as well.

Temming, Maria. “Stem's Racial, Ethnic and Gender Gaps Are Still Strikingly Large.” *Science News*, 14 Apr. 2021, www.sciencenews.org/article/science-technology-math-race-ethnicity-gender-diversity-gap.

This article addresses the disparity between different groups of people within the Stem field.

Understanding Science, undsci.berkeley.edu/index.php.

This website aims at helping people understand science in a relatable way.

Resources for Teachers

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