pH Lesson Plan - Experimental

Executive Summary: In preparation to meet the cosmetology state board requirements students will learn about what makes the pH of a substance either acidic or alkaline along the pH scale through building a pH sensor and calibrating it using a visualizer. Students will then use the scientific method to hypothesize the pH of various hair products and test them using the pH sensor.

Based off of their knowledge of different hair products, students will come up with a local business that promotes natural hair care. They will come up with a product that will be health for hair care and produce a sample. Students will then use the scientific method to hypothesize the pH of their hair products and test them using the pH sensor.

Week 1

Title: Computing meetings Chemistry in Cosmetology

Summary: In preparation to meet the cosmetology state board requirements students will learn about what makes the pH of a substance either acidic or alkaline along the pH scale through building a pH sensor and calibrating it using a visualizer. Students will then use the scientific method to hypothesize the pH of various hair products and test them using the pH sensor. Students will share out their findings at the end of the class.

Time Duration: 7.5 Hours

Tools: PC; Arduino; Solderless breadboard; USB cable; Scientific Atlas pH sensing kit (pH Circuit; scientific grade silver / silver chloride pH Probe; (4oz) calibration solutions (pH 4, pH 7 and pH 10); (4oz) pH storage solution; Pre-Assembled Female BNC connector); Cast acrylic sheet (.236” thick); 22 AWG wire (black, red, and any other color); Double sided tape; Safety gloves, safety goggles, paper cups, lab coats; hair products that have different levels of pH (e.g. shampoo, dye, relaxer, etc.),

Resources: Node Arduino; CSDT pH Visualizer

Handouts: Vocabulary; Sensor build; visualizer; calibration; scientific method

Learning Outcomes: Label and identify pH scale; apply log to pH scale; identify acidic and alkaline hair products; identify hydroxide or hydrogen ion density for different products.

Deliverable: pH probe for an experiment to test various hair products.

***Lesson 1* - 1.5h**

Pretest - 25mins

Explain to the class that we are collecting data for a National Science Foundation grant: As part of this research we collect data on integrating science, technology, engineering and mathematics with cultural content. In this lesson we will use computers in the context of cosmetology. To study how effective this lesson is we would like you to take a pre and post test, basically to see if what we did was helpful for you, the learners, and Mrs. Love,. This test is not mandatory or graded. Your personal information will be kept confidential and only represented as part of a larger set of data.

Instructors will administer the pretest, giving students 20 mins to complete it.

Introduction - 5mins

Explain that students will learn about pH in hair products and other solutions. They will learn about the pH scale by building and calibrating a pH sensor with a small micro-controller, called an Arduino. They hypothesize the pH of different hair products and use the pH sensor to test their hypotheses.

Mini-Lesson 10mins

Introduce lesson developed with pH vocabulary from Milady Standard in context of high school cosmetology (Cos 2).

Acidic solution - A solution that has a pH below 7.0 (neutral)

Alkaline solution - A solution that has a pH above 7.0 (neutral)

Alkalis - Also known as bases; compounds that react with acids to form salts.

Anion - An ion with a negative electrical charge.

Cation - An ion with a positive electrical charge.

Ionization - The separation of an atom or molecule into positive and negative ions.

Ion - An atom or molecule that carries an electrical charge.

Hydrogen ion - A positively charged nucleus of hydrogen that does have have an electron

Hydroxide ion - An oxygen and hydrogen atom that carries a negative charge and is held together by a covalent bond

Potential hydrogen (pH) - Abbreviated as pH. pH Represents the quantity of hydrogen ions.

pH Scale - A measure of acidity and alkalinity of a substance; the pH scale has a range from 0-14, with 7 being neutral. A pH below 7 is an acidic solution; a pH above 7 is an alkaline solution.

Logarithm - Multiples of 10

Guided Practice - 20mins

Students will learn how to apply the vocabulary to the pH scale and learn about the pH of solutions that have pH.

Activity - 30mins

Students will match different solutions to pH levels along the scale.

***Lesson 2* - 1.5h**

Introduction - 5mins

Explain that students will get a small refresher on yesterday's content and specifically how to label the pH scale and what acidic and alkaline solutions are. They will learn about some different techniques for measuring pH before beginning to build a pH probe to measure pH themselves.

Mini-lesson - 15mins

Refer students to the vocabulary handout and go over:

Acidic solution - A solution that has a pH below 7.0 (neutral)

Alkaline solution - A solution that has a pH above 7.0 (neutral)

Potential hydrogen (pH) - Abbreviated as pH. pH Represents the quantity of hydrogen ions.

pH Scale - A measure of acidity and alkalinity of a substance; the pH scale has a range from 0-14, with 7 being neutral. A pH below 7 is an acidic solution; a pH above 7 is an alkaline solution.

Project an image of the pH scale on the screen. Introduce each part, first the colors, then numbers, and finally the acidic, neutral and alkaline labels.

Project images of products on the screen: lemon juice, ammonia, baking soda, hair and skin, distilled water. With the first two (lemon juice (2 acidic) ammonia (12 alkaline)) give them the number and ask for volunteers to identify if it is more acidic or alkaline. Once they get it right, visually show them where it falls on the pH scale. With the next two (baking soda (8 alkaline) and hair and skin (5 acidic) tell them whether it is alkaline or acidic and aks for volunteers to guess numbers. Finally show distilled water (neutral 7) give them no labels and ask to fill in both number and neutral.

Guided Practice - 20mins

Tell students that there are different ways to measure the pH of solutions and products. Explain that it is easiest to measure the pH of solutions. Explain that there are many ways to measure the pH of a solution but for this unit we will talk about 2: computer programmed pH sensors and pH litmus strips.

Use acidic, alkaline, and neutral solutions to demonstrate with both the pH sensor and the litmus strip. Ask for volunteers and have them test out the different solutions: comparing the paper to the box (pink for acid, blue for base and purpose for neutral) and looking at outputs on the serial monitor.

Pass out the Arudinos, pH sensor sand pH probes boxes. Pass out the inventory list . Have students open their boxes. Hold up each item one by one (Ardunio, USB, Scientific Atlas pH sensing kit (pH Circuit: pH Probe; calibration solutions; pH storage solution; Pre-Assembled Female BNC connector); Cast acrylic sheet (.236” thick); 22 AWG wire (black, red, and any other color). Have students hold up each item and check it off on their inventory list.

Pass out the “pH sensor build” handout. As a class walk through the steps to build the sensor.

Activity - 40mins

Students will build the pH sensor by following the pH sensor build handout.

Share-out - 10mins

Pass out the “Day 2 Prompt” handout that reads: As a cosmetologist, why and how might you discuss pH with your customers?

Give students 2 minutes to write down answers and 5 minutes to share out before class ends.

***Lesson 3* - 1.5h**

Introduction - 5mins

Explain to students that they will get a small refresher on the pH scale and dive a little deeper into ions before calibrating the sensor and opening the visualizer.

Mini-lesson 1 - 15mins

Project an image of the pH scale. Ask students to recall what they learned yesterday and ask volunteers to define the following terms: acid solution, alkaline solution, pH, and pH scale. Refer students to the vocabulary handout and go over:

> Ion - An atom or molecule that carries an electrical charge.
>
> Ionization - The separation of an atom or molecule into positive and negative ions.
>
> Hydrogen ion (H+) - A positively charged nucleus of hydrogen that does have have an electron. More of these result in more acidic solutions.
>
> Hydroxide ion (OH-) - An oxygen and hydrogen atom that carries a negative charge and is held together by a covalent bond. More of these result in more alkaline solutions.

Project an of image water molecule (H20) that makes the two hydrogen atoms and an oxygen atom. Explain that pH is only possible because of the ionization of water (the separation a molecule into positive and negative ions).

Explain that we can think of water as a neutral substance, as it appears on the pH scale. It is neither acidic or alkaline.

A substance becomes acidic if it has more hydrogen ions. Show a hydrogen ion. But make clear to students that the more hydrogen ions that there are the the smaller the number on the pH scale gets. Show two substances lemon juice and vinegar. Explain that both are acidic but the juice as a pH of 2 while the vinegar has a pH of 3. Ask them which substance has more hydrogen ions. Hopefully they will say the juice and have them explain why. Then ask them which substance has less hydrogen ions. Hopefully they will sae the vinegar and have them explain why.

Next explain that water can become more alkaline if there are more hydroxide ions. Show a hydroxide ion. Make clear that the more hydroxide ions there are the greater the number on the

pH scale will be. Show two substances baking soda and ammonia. Explain that both are alkaline but that the baking soda is a pH of around 8 and ammonia is a pH of 12. Ask them which substance has more hydroxide ions. Hopefully the will say the ammonia and have them explain why. Next ask them which substance has less hydroxide ions, hopefully they will say the baking soda and have them explain why.

Now show the acidic substances on the screen and tell students we are going to ask a harder question. Which one of these substance has a greater amount of hydroxide ions? Hopefully students will say vinegar. That is right, even acidic substances have hydroxide ions. Ask the same about hydrogen ions for the alkaline substances to clarify the point that there are hydrogen ions in alkaline substances and hydroxide ions in acidic substances.

Mini-lesson 2 - 30mins

Lakisha Foy, a natural hairstylists and entrepreneur, will guest lecture on her use of pH in the salon context.

Guided Practice - 10mins

Have students get their build pH sensors and pass out the “calibration” and “visualization” handouts. Have students check their items list to make sure they have all the materials.

Draw their attentions to the calibration hand out. Walk students through the handouts, demonstrating them how to calibrate the pH sensor on the projector.

Draw their attention to the visualizer hand out. Walk students through the hand out, demonstrating how to open the visualizer on the projector.

Activity - 25mins

Students will calibrate their sensors and open the visualizers.

Share-out - 10mins

Pass out the “Day 3 Prompt” handout that reads: As a cosmetologist, how might you use computing technologies to support your practice and teach your customers about pH?

Give students 2 minutes to write down answers and 5 minutes to share out before class ends.

***Lesson 4* - 1.5h**

Introduction - 5mins

Explain to students that they will first learn about what the different numbers mean, mathematically, on the number scale before they come up with hypotheses about different hair products and begin testing their hypotheses with the pH probe.

Mini-lesson - 20mins

Project an image of the pH scale and ask students to recall what they learned on Tuesday and ask volunteers to define the following terms: acid solution, alkaline solution, pH, and pH scale.

Project images of hydrogen and hydroxide ions. Ask them to recall what they learned yesterday and ask volunteers to define the following terms: ion, ion, hydrogen ion, hydroxide ion.

Project an image of the pH scale with the log values representing. Refer students to the vocabulary handout and go over:

Logarithm - multiples of ten.

Pass out the “log” worksheet with the questions where students have to decide how many more times acidic or alkaline a change in a substance is. Show students how to calculate how many more or less times something is acidic or alkaline by using multiples of 10. Show students how to represent this as an exponent. Again give them the substances of lemon juice, vinegar, distilled water, baking soda, and ammonia. As a group work though five questions and write the answers on the board.

How many more times acidic is lemon juice than vinegar?
How many more times alkaline is ammonia than baking soda?
How many more times acidic is vinegar than distilled water?
How many more times acidic is ammonia than baking soda?
How many more times alkaline is ammonia than lemon juice?

Guided Practice - 20mins

Pass out the the “scientific method” worksheet that has: Identify the problem; state your hypothesis; explain the experiment; what and how will data be gathered; how will you organize your data; and conclusion. Walk students through the scientific method and fill it out as a group by using sensor to test one product. Reminds students that they should use their educated guesses about pH and the ingredient list on the products to make their best guesses.

Pass out the the “pH reading” worksheet. Show students where to fill in hypothesis, pH reading, and conclusion for each of their products.

Activity - 35mins

Students will come up with hypotheses, test products to record their pH, and write out a conclusion.

Share-out - 10mins

Pass out the “Day 4 Prompt” handout that reads: Would it be helpful to include pH of hair products on the packaging? Why or why not? Why don’t you think it is currently included?

Give students 2 minutes to write down answers and 5 minutes to share out before class ends.

***Lesson 5* - 1.5h**

Introduction - 5mins

Explain to students that they will finish up their experiments today, we will draw conclusions about the the different hair products. First we will get a quick refresher.

Mini-lesson - 20mins

Refer students to the vocabulary handout. Ask students to define each of the vocabulary words.

Acidic solution - A solution that has a pH below 7.0 (neutral)

Alkaline solution - A solution that has a pH above 7.0 (neutral)

Alkalis - Also known as bases; compounds that react with acids to form salts.

Anion - An ion with a negative electrical charge.

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Ionization - The separation of an atom or molecule into positive and negative ions.

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Hydrogen ion - A positively charged nucleus of hydrogen that does have have an electron

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Potential hydrogen (pH) - Abbreviated as pH. pH Represents the quantity of hydrogen ions.

pH Scale - A measure of acidity and alkalinity of a substance; the pH scale has a range from 0-14, with 7 being neutral. A pH below 7 is an acidic solution; a pH above 7 is an alkaline solution.

Logarithm - Multiples of 10

Project a pH scale on the board that does not include numbers or acidic, neutral, or alkaline on it. Ask for volunteers to fill it in. Once it is filled in asked:

How many more times acidic is lemon juice than vinegar?
How many more times alkaline is ammonia than baking soda?
How many more times acidic is vinegar than distilled water?
How many more times acidic is ammonia than baking soda?
How many more times alkaline is ammonia than lemon juice?

Activity - 30mins

Students will finish their experiments using the pH sensor.

Share-Out - 10mins

Pass out the “Day 5 Prompt” handout that reads: What did you learn about pH and hair products that you did not expect or found surprising.

Give students 2 minutes to write down answers and 5 minutes to share out before class ends.

Post-test - 25mins

Remind students that all information will be kept confidential. Instructors will administer the pretest, giving students 20 mins to complete it.

Week 2

Title: Locally Sourced Natural Hair Care

Summary: Based off of their knowledge of different hair products, students will come up with a local business that promotes natural hair care. They will come up with a product that will be health for hair care and produce a sample. Students will then use the scientific method to hypothesize the pH of their hair products and test them using the pH sensor.

Time Duration: 7.5 Hours

Tools: PC; Building Arduino pH sensor; Safety gloves, safety goggles, paper cups, lab coats; natural products for hair care.

Resources: Node Arduino; CSDT pH Visualizer

Handouts: Scientific method; Natural hair care handout.

Learning Outcomes: Develop awareness of natural hair care and

Deliverable: Natural hair care product sample and presentation

Lesson 1 -
Introduction

Mini-lesson

Guided Practice

Activity

Share-out

Lesson 2 -

Introduction

Mini-lesson

Guided Practice

Activity

Share-out

Lesson 3 -

Introduction

Mini-lesson

Guided Practice

Activity

Share-out

Lesson 4 -

Introduction

Mini-lesson

Guided Practice

Activity

Share-out

Lesson 5 -

Introduction

Mini-lesson

Guided Practice

Activity

Share-out