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GREEN-EDU Learning Activity

Title: Nature and Chemistry

Author(s):

Summary: 9.5.1.3 explains the hardness and softness properties of water. The aim of this lesson plan with the acquisition is to make students realize some properties of water and to identify the ions that cause these properties. Various robotic codes were used to identify these ions.

Lesson plan summary	
Subject	*Green Chemistry / Green Biotechnology / Green Engineering and Robotics*
Topic	*Water and Life*
Age of students	
Preparation time	*15 Minutes*
Teaching time	*2*40 Minutes*
Online teaching material (links for online material)	
Offline teaching material	

Aim of the lesson

· At the end of this course, students will be able to:

-Understand the different properties of water used in daily life.

Scoala Gimnaziala Nr. 16 „Take Ionescu"
Timisoara, Str. Bucuresti Nr.11
Tel: 0256/292889
e-mail: eco_scoala_16tm@yahoo.com

-Recognize ions that cause water to be soft and hard.

- Realize the advantages and disadvantages of hard and soft water in our daily life.

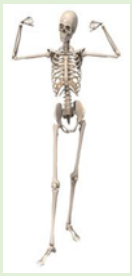
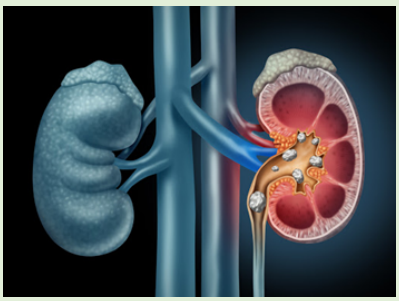
-Analyze data in line with the information they have acquired.

Trends

STE(A)M Learning/ project based learning /presentation method / discovery learning / brainstorming / question-answer

Activities

Describe here in detail all the activities during the lesson and the time they require. Remember, that your lesson plan needs to revolve around the topic of green engineering and robotics.

Name of activity	Procedure	Time
Engage-1	After the teacher enters the classroom and asks the students how they are, then s/he gives a glass of tap water and a glass of boiled and cooled tap water, both are 15 C, to 3 volunteered students. They taste the water then the teacher asks the reason of difference between them.	
Explore-1	    	

The teacher shows the students these visuals that she has pasted on the board and asks the same question again and notes all the answers on the board

Explain-1

Measuring the Hardness Level of Water

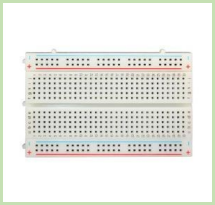
Materials List to Use:

1. Arduino Robotic Coding Board
2. 1x 1k Ohm Resistor
3. 1x 2 Pin Power Cable
4. 1x Breadboard Jumper Cable
5. Mblock IDE Program

1. Arduino Uno cable

2. Ik Ohm resistor

3. Pin power



4. Breadboard

5.Jumper Cable

6. Mblock IDE

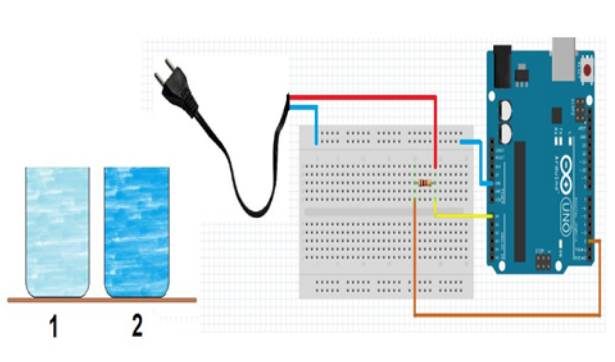
Data to be Obtained:
Hardness is one of the criteria used to describe the composition of water. The hardness of the water is important for the longevity of industrial products although it has no known effect on human health. In our experiment, a power cable will be immersed in 2 different water environments and the values will be measured from the analog pin of the Arduino Uno board. If the measured value is low, the water

x min

	is hard and if it is high, it is soft. The data collected at the end of the experiment will be voltage. Expectation: In the values to be measured with the setup to be installed, it is expected that the environment where low values come from is hard and its conductivity is high.	
Elaborate-1	The Project for Measuring the Hardness Level of Water Goal: There are metals such as Magnesium, Chlorine etc. dissolved in water, and these metals harden water and make it difficult to use. Although it is healthy because it meets the metal need in the body when drunk, it is harmful in home or industrial use because it covers the resistances of the machines and blocks the pipes. These waters need to be softened. In this project, the measurement and differentiation of hard and soft waters by Robotic Coding will be shown. **Designing the Experiment Setup:** In our experiment, two kinds of water of different hardness will be supplied and placed in two identical glasses. The necessary circuit will be established and hardness measurements will be made after the code blocks, we need are placed in our Mblock program. If there is more molten metal in the water, the value will be low when it is measured. Thus, the lower value will be able to say that the water is harder. **Design of Experiment Setup:** In our experiment, a faucet to provide water flow will be used. When someone who wants to wash his hand extends his hand, an IR sensor will detect this hand, and a relay and solenoid valve will be used to control this tap when the hand is detected. In addition, a container will be used to collect the used water, and the level of the accumulated water in this container will be measured. **Setting Up the Experiment:** The experimental setup will be designed as above: There will be two glasses of water with different hardness in front of us. · European type socket will be used as a sensor. 5 Volt voltage will be given from one end of the socket for a short time and the voltage value taken from the other end will be evaluated. · If the voltage value read from the other end of the socket is high, it is close to the waterproofing, that is, there is not much molten metal in the water. Therefore, water will mean soft. · If the voltage value read from the other end of the socket is low, it can be said that water is close to the conductor, that is, there is too much molten metal in the water. Therefore, water will mean hard. **Necessary materials:** 1 x Arduino Uno Robotic Coding Board	25+25 min

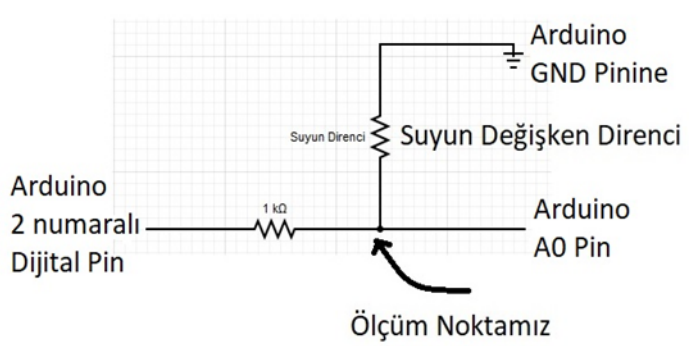
1 x Breadboard
1 x 1kohm Resistor
1 x 2 pin European Power cable
5 x Jumper cable

Making Circuit Connections:
First of all, as mentioned above, two glasses of water with different hardness will be taken into the test environment. The connections of other electronic materials to be used will be made as follows.



· One pin of the power cable will be connected to Arduino's GND pin and the other pin to Arduino's A0 pin.
· One end of 1Kohm resistor will be connected to A0 pin of Arduino and the other end to digital pin number 2 of Arduino.

When we do the electronic analysis of the above project, the following electronic circuit appears.

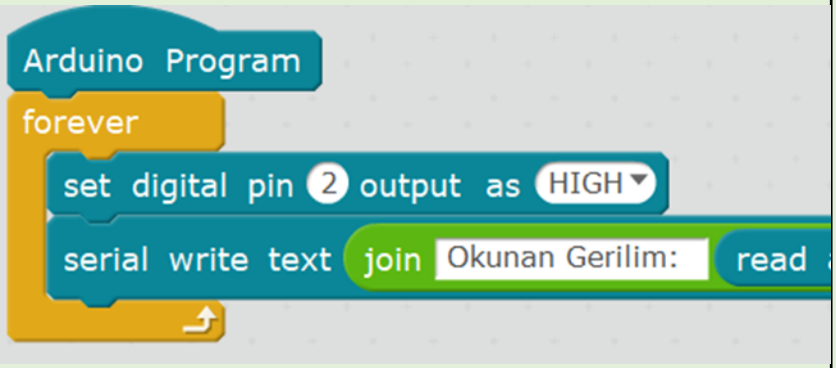


As can be seen from the above figure, our experimental environment consists of an electronic circuit. The hardness of the water we measure expresses its density in terms of metal and also its resistance.
If the water used is hard, it will mean a lot of metal dissolved in water. Even if there are many metal ions, the current supplied will easily reach the opposite pin, meaning that the resistance is low.
If the water used is soft it will mean less metal dissolved in the water. Even if the metal ions are low, the current given will hardly reach the opposite pin, meaning that the resistance is high.
Since our experiment environment is electronically resolved, the value read from Arduino's Analog A0 pin can be interpreted. When 5V is supplied from Arduino's Digital pin number 2, voltage will occur on the resistors in direct proportion to the size of the resistors

according to Kirchoff's Law. If the water is hard, that is, its resistance is low, the voltage value read from Pin A0 will be low. If the water is soft, that is, its resistance is high, the voltage value read from the A0 pin will be high. Since the Voltage value is read as output in this project, the output value must be interpreted according to the above principle.

Coding

The application we will use for coding is the Mblock program. This application is a tool that allows us to do robotic coding by dragging and dropping blocks without the need for programming language knowledge. Coding block is below.



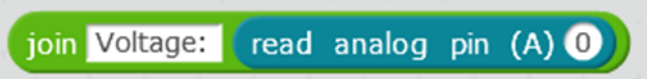
If we explain the application steps one by one:

Make the numeric pin "high" block:
This block refers to the pin number given in parentheses.
It provides sending 5V voltage value from Arduino. 5V from the pin 2 number of Ardunio is sent to the electronic circuit and their resistance voltage drop is provided on it.

Analog pin read (A0) block:
It indicates that the data has been read From Arduino's A0 Analog pin. Data here is the voltage received.

combine () with () block:
It indicates that in the article sent to the computer via USB cable

in the first bracket and in the second bracket will be combined



Combine () with () and Write Series Port block:
It combines what is written in parentheses and sends this value to the serial port, to the computer. Here "Read Voltage:" and it will combine the value read from the A0 pin of Arduino, that is the Voltage value, and write it to the Serial port, that is, send it to the computer.

Repeat Continuous Block:
As long as the Arduino is open, the blocks placed inside ensures continuous repetition. So, it measures and informs every 5 seconds about the hardness of water. This is done as long as the Arduino is not shut down.

Arduino Program block

This block represents energizing the Arduino Robotic Coding device. It means that code blocks added as a chain will be executed when energized and started to run.

● As a chain to the block "When Arduino Uno starts" "continuous repeat block" is added, so it will be entered into this block first.
● Inside the continuous repeat block, there is a code block that sends 5V from Arduino's digital pin number 2. This 5v water goes to a pin of the socket.
● A delay of 10 milliseconds has been given to make a measurement.
● Later, the voltage coming to the Analog A0 pin of Arduino was measured and combined with the text "Read Voltage:" and printed from the serial port to the computer. This reading voltage indicates the hardness of the measured water. It can be said that if the voltage read is high, the water is soft, if the voltage is low, the water is hard.
● After reading the voltage from analog A0 pin, the voltage sent from Arduino's digital pin number 2 is cut off.
● Waiting for 5 seconds at the last time, and the above described operations were presumed to be performed again.

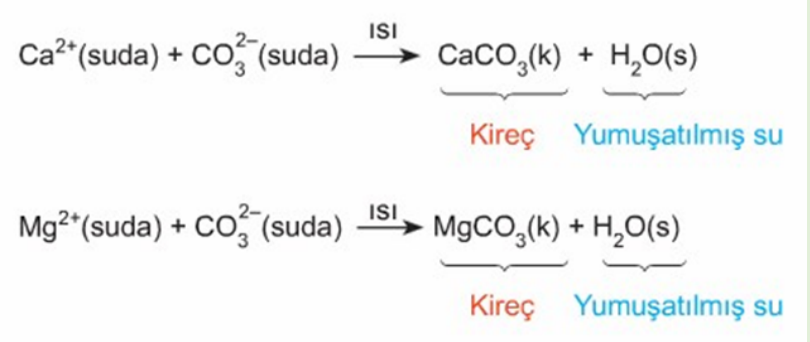
Hard and Soft Water
Water dissolve various minerals in igneous and sedimentary rocks. Various ions contained in these minerals dissolve in water to form hard water. Excess of minerals containing Mg2 + and Ca2 + ions dissolved in water causes the water to be hard. The less Mg2 + and Ca2 + ions in the water indicates that the water is soft.

Effect of Hard Water
Hard water creates lime in household items such as faucets, sinks, bathtubs, and teapots over time. Resistors that act as water heaters in electrical household appliances such as washing machines, dishwashers and irons become calcified over time and their operating efficiency decreases. In this case, electricity consumption will be higher. Hard water reduces the effect of the cleaning agent, causing more cleaning agent to be used. In addition, the wear and color fading of the clothes are the effects of hard water.

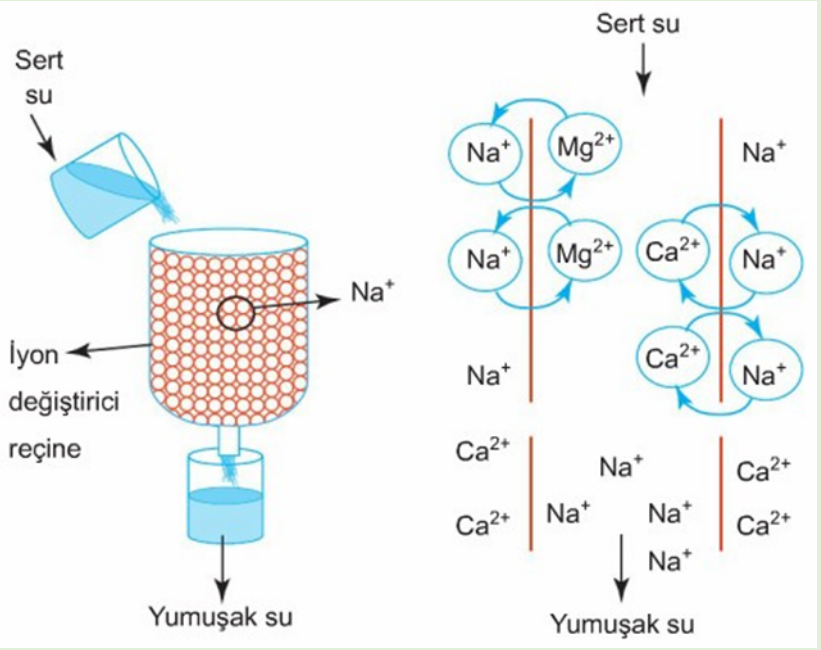
Important: Water of normal hardness is important for our health. Thanks to the ions they contain, they are necessary for our bone development. Because the structure of our bones consists of the mineral, we call calcium phosphate (Ca3 (PO4) 2).

How to Eliminate the Hardness of Water?
Various methods can be used to soften the water.

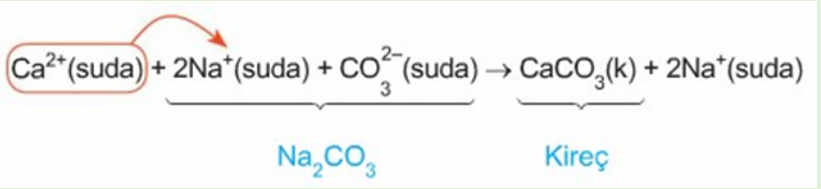
1. When hard water is boiled, it is removed by the precipitation of ions (Mg2 +, Ca2 +) in the water.
2.



2. Another method of removing the hardness of water is to use ion exchange resin. Calcium (Ca2 +) and magnesium (Mg2 +) ions that give hardness to water are replaced by sodium (Na +) ions in the resin. Thus, the hardness of the water is removed.



3. Washing soda is used to remove the hardness in water. The chemical formula of washing soda is Na2CO3. The sodium ions (Na +) in washing soda and the magnesium (Mg2 +) and calcium (Ca2 +) ions in hard water form a precipitate (lime) by exchanging them.



Thus, ions that give hardness to water are precipitated. Descaler is used to prevent limescale of household items such as washing machines and dishwashers. Lime Solvents can be obtained from acids such as HCl. It is also used to remove lime in places such as teapots, sinks, bathtubs.

5. Evaluation

Materials Used:
Required materials to be used: Coal dust, large pebbles, small pebbles, fine sand, coarse sand, dirty water, plastic bottle, tissue roll, glass
Substances that are not mandatory to use: You can use 5 different materials you want.

Knowledge-Based Life Problem
Aunt Ayşe, who lives in Antalya, is a retired teacher. Aunt Ayşe, who spent most of the year in the center of Antalya, goes to the plateau in the summer months. One day, Aunt Ayşe was sitting in her highland house and her guests came and made tea. The tea that Aunt Ayşe made looks extremely clear. This situation surprises Aunt Ayşe.

x min

Because whenever he made tea at his house in Antalya, his tea becomes unclear. Wondering the reason for this, Aunt Ayşe does research. Aunt Ayşe, who learned that the hardness of the water she used in her house in Antalya was higher, sought a solution. And he has learned that if he uses a water purifier, he won't have this problem.
Could you design a water purification device to help Aunt Ayşe?

Limitations:
6 materials should be selected from among the materials.
· The product you have made must really be able to purify water.
· An advertisement must be designed for the sale of the product and a price must be determined for the sale of the product.

Evaluation of the Product Created:

	Very good	Middle	Should be developed
Is the product created working?			
Are the restrictions respected?			
Has technology been utilized in the created product?			
Is the ad created effective?			
Is the price determined for the created product appropriate?			

		Is the design of the product impressive?				
						X min

Assessment

Describe here the assessment method of the lesson, if any. For example, if you plan on assessing your students with a quiz, include here questions and answer options with color-coding the correct answers.