Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

2003350: CHEMISTRY I HONORS

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RET Site: CoMET Lesson/Unit Plan

Course(s): ***2003350 Chemistry I Honors; 2003340 Chemistry***
Grade Level: ***10th & 11th***
Suggested Length of Lesson: 1 block period (90-100 mins) or two regular (45-50 mins) class days

Materials/Technology Needed

- Each group of students (2-3 students per group) should have the following materials:
  - 6 (250 mL or less) clear glass beakers
  - 1 (100 mL) graduated cylinder
  - 1 (10 mL) graduated cylinder or volumetric pipette
  - A piece of solid green or blue construction paper (letter size)
  - One Android® internet capable phone with the "Color Grab" color sensor app installed or similar app can determine the RGB color code of an image.
  - 500-600 mL of a clear (brown, red or yellow) juice product (e.g., Cranberry Juice, Sweet Tea, Apple Juice, etc.).
  - A computer or phone installed graphing tool (e.g. Excel™, LoggerPro™, Desmos® app for Android)

Where this Fits

- Units where this lesson can be incorporated include, but is not limited to:
  - Measurements and Data Processing
  - The Scientific Method
  - Engineering Design Process
  - The Electromagnetic Spectrum
  - Electrons and the Atom
  - Spectroscopic Techniques
  - Analytical Chemistry
  - Food Chemistry

Lesson Objective(s)/Learning Goal(s)

- The student will construct a sample holder using origami.
- The student will prepare standard solutions of varying concentrations for a calibration curve.
- The student will construct a calibration curve to determine the relationship between color intensity and % juice.
- The student will determine the % juice in an unknown diluted sample of juice.
- The student will calculate the sugar content in the diluted sample.

Standard(s)/Benchmark(s) Addressed

- *Florida NGSS Standards:*
- *Chemistry*
  - ***SC.912.P.10.9*** *Describe the quantization of energy at the atomic level.*
- *Physics*
  - ***SC. 912.P.10.18*** *Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications.*
- ***National NGSS:***
  - ***HS-PS4-5.*** *Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.**

Standards for Mathematical Practice

- *Florida NGSS Standards:*
  - *MAFS.912.F-IF.2.4 For a function that models a relationship between two quantities, interpret key features of graphs*
  - *MAFS.912.G-GMD.1.2 Apply concepts of density based on area and volume in modeling situations*
  - *MAFS.912.N-Q.1.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*
  - *MAFS.912.S-ID.2.6 Represent data on two quantitative variables on a scatter plot*

Evidence of Learning (Assessment Plan)

- Pre-test on electromagnetic spectrum and interpreting graphs
- Formative evaluation of students working collaboratively
- Formative evaluation of students working successfully (sensors are working)
- Formative evaluation of individual students by asking random students
- Assessment of their % error in the lab activity
- Post-test on electromagnetic spectrum and interpreting graphs

Instructional Strategies

- General Instructional Strategies
  - Collaborative Groups
  - Cooperative Learning
  - Use of Technology
  - Problem Solving
  - Small Group Instruction
  - Whole Class Instruction
  - Modeling/Scaffold Instruction
  - Incremental Pacing of Instruction
  - Checking for Understanding
  - Providing Verbal Immediate Feedback
  - Providing Written Feedback
  - Review of Material
- ELL Strategies
  - Paired Reading
  - Group Activity
  - Preferred Seating
  - "Hands-on" Activity
  - Dictionary for Reference
- ESE Strategies
  - Guided Inquiry
  - Preferred Seating
  - Repeat of Instruction
  - Clarification for Understanding
  - Other strategies listed in individual student's IEP/504

Description of Lesson Activity/Experiences

1. Take the Pre-test.
2. Construction of the sample holder following the instruction provided by Do It Yourself on youtube.com: https://www.youtube.com/watch?v=caDwbe02l6g
3. Download the "Color Grab" app for android or similar app for iOS.
4. Get familiar with the app by playing around with it.
5. Prepare the diluted standard solutions for the calibration curve. Each group decides how many and what % of juice each standard solution will contain (3-5 is suggested).
6. Place each standard in the sample holder and use the app to grab the color (the green code in the RGB code).
7. Collect data (be aware of repetition of experiments removal of outliers).

8. Graph data (each group decides how best to graph and present the data).
9. Provide the best line equation and R^2 value for the data.
10. Get a sample of the prepared unknown solution and test it.
11. Calculate the % error in the sample after getting the actual value from the teacher.
12. Answer the follow up questions.
13. Write a lab report summarizing your experiment.
14. Take the Post-test.

Recommended Assessment(s) and Steps

- Pre-test
- Formative Evaluation (answering verbal questions by teacher)
- Written follow-p questions
- Lab Report
- Post-test

List of Materials/Resources Used

- "Color Grab" App for Android
- Youtube video: https://www.youtube.com/watch?v=caDwbe02l6g

Important Vocabulary

Term	Definition
Environmental Sensor	A device that detects a property of surroundings
Color Sensor	A device that detect the color of a substance.
Atomic orbital	Region in space where an electron can be found.
Electromagnetic Spectrum(EMS)	Various forms of light list in order of increasing/decreasing energy.
Electron Configuration	A notation that tells you where the electrons are located in an atom.
Electron dot structure	A notation that depicts the valence electrons in an atom.
Energy	The ability to do work (the product of frequency and Planck's constant).
Energy sublevel	The shape of the region where the electron is located.
Frequency	How many waves per second passing through a particular point (Hz or 1/s).
Ground state	The initial energy level of an electron.
Excited State	The resulting energy level of an electron after absorption.
Light	Electromagnetic radiation.
Photon	Small particle without mass that makes up light.
Principal energy level	The main level where an electron is located.
Wavelength	The distance from crest to crest of a wave, measure in nanometers, smaller wavelength means higher frequency
Radiation	Light of any energy (but usually high energy)

Colorimetry	Measuring properties of solutions using the visible region of the EMS.
Spectroscopy	Measuring properties of solutions using any region of the EMS.

Troubleshooting Tips

If the calibration curve is not fitting a linear regression, try using the white light balancing feature on the "Color Grab" app.
Also be sure students are "grabbing" the color intensity of the solution at the same height, resting the phone on the sample holder with stabilize the app and ensure the color is grabbed at the same height. Only one phone should be used to construct the curve and determine the unknown solution.

Other Helpful Information

Blue construction paper can be used instead of green as the color has a higher energy than the red colored juice. If using a different colored juice as the analyte. Be sure the color of the sample holder has a higher energy than the color of the juice. Remember ROYGBIV.

Students may compare their results to that of a traditional colorimeter or spectrophotometer and among each other.

Attachments

- PowerPoint on Colorimetry (spectroscopy)
- Pre-test
- Post-test (same as pre-test)
- Pre-test answer key
- Post-test answer key (same as pre-test)
- Follow up questions
- Follow up questions answer key
- Lab Report format (template)

References

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