The Art of Cross-Curricular Teaching: An Introduction to IoT to High School Chemistry

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Summary

The National Science Foundation funded a Research Experience for Teachers (RET) program hosted by the University of Central Florida.
Research activities presented:

- Flexible Strain SensorSystems Track)
- Coding through JAVA and C languages
- Software Networking & Mobile Programming

Classroom Implementation:

- Introduction to Titration with graph interpretation
- Determining Concentration via PH sensors

- Hardware Platform Module (Embedded Introduction to Data Programming
- Internet of Things research
- The program is designed to inspire students to pursue careers in STEM and computer programming.

Research Activities

Module 1: Design and Fabrication of Environmental Sensors

- Introduction to methods of photolithography
- Advantages and efficiency of scaling
- Etch a design on silicon wafer
- Detect heavy metals through electrode

Module 2: Hardware Platform Module

- Basics of Binary and Hexadecimal
- Truth tables, Conditional Statements, & Loops
- Programming in C-Language and Virlog
- Introduction to the MSP430

Module 3: Software and Networking

- Programming in Java
- Introduction to a Raspberry Pi
- Layers of OSI Networking
- Design and host a webpage using HTML
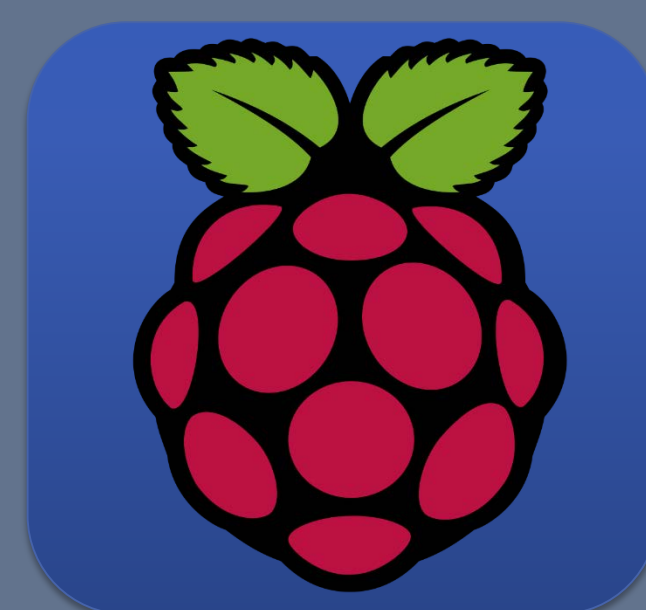
Module 4: Mobile Programming

- Create Android apps using JAVA and XML
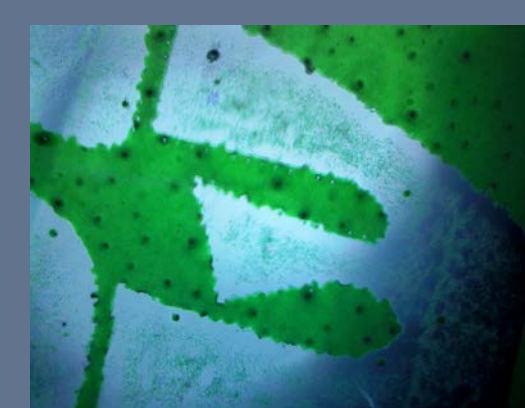- Connect Raspberry Pi to Android

Lesson Plan

A note to the reader:

This lesson is embedded as a post lesson application assessment pre-test.

- *Determining concentration via titrations*
- *Identifying Reaction Rates & Equilibrium*
- *Perform data programming of PH sensor*
- *Analyze and hypothesis result and conclusion*

Day 1 Sensors/Microchips

- Pre Lab Preparation and Set Up
- Review of Equilibrium/Acid and Base
- PH sensor Familiarization and Functioning
- Lecture on La Chatelier's Principal and Lab
- Daily Lab Journal Entry

Day 2 Computer/Sensor Programming

- Group Collaboration with Data Mate
- Simultaneous Lecture with application
- Complete titration and make Hypothesis
- Daily Lab Journal Entry
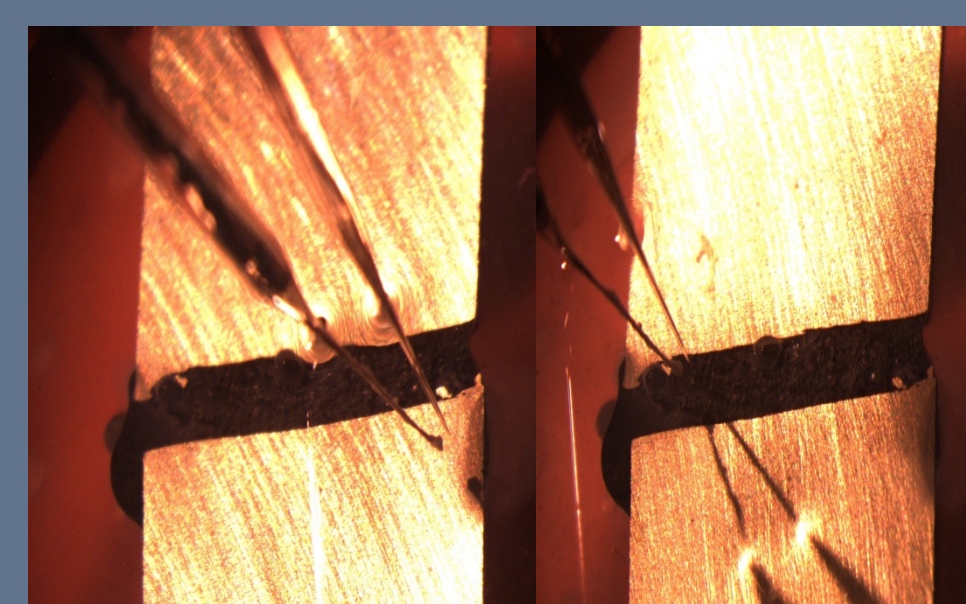
Day 3 Deepening Practice with Sensor Results

- Notes on Conditional Statements
- Work in partners to create verbal conditional statement
- Quick Write reflection about the day's activities

Day 4 Internet of Things / Hypothesis Reflection

- Notes on Spinoffs & Internet of Things
- Students perform further research on other NASA Spinoffs
- Unit Post-Test

Lessons Learned

The knowledge I have gained with the RET (CoMET) has given me a new and refreshed outlook on how I approach STEM. The following are areas in which my knowledge was most enhanced:

- The fabrication of sensors and microchips
- Basic coding in JAVA and C
- Networking in Education
- Applications of the Internet of Things

The opportunity to participate in this program have privileged me to learning the most cutting edge technologies and how the IOT is and will always be a part of what we do as life long learners, educatiors, students and human beings.

Implementation Strategy

In Chemistry, Acid and Base lesson, the standards require students to understand how technology and space exploration affect Florida's economy. This additional IoT unit explores the development of technology from the hardware, through programming, and finally to applications for NASA and consumer market spinoffs.

The lesson plan was designed with multiple means of presentation and included the following learning strategies:

- Audio/Visual Lecture
- Journal and Note Taking
- Hands-on Experience
- Guided/Independent Inquiry and Reflection
- Peer-support Activities
- Characterize types of Reactions
- Explain the Concepts of Dynamic Equilibrium
- Relate Acidity to Basicity

Acknowledgments

References

Anthony C Wilbraham, Dennis D Stanley and Michael S. Malta (2012). Pearson Chemistry; Prentice Hall; 978-0-13-252576-3.

World Health Organization, "Acceptability aspects: Taste, odor and appearance," in *Guidelines for Drinking-Water Quality*, 2011, pp. 226–227.