Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

Physical Science Honors:2003320

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Course Number and Name: Physical Science Honors, #2003320

7/7/2017

READ THIS FIRST

- Write all lessons and activities in present tense.
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- These lessons will be published. All work should be your own. Be sure to cite references where appropriate and only use images in the public domain/creative commons or that you develop. All lessons will be run through turnitin.com prior to publication.
- Remember to do your 3R reflection include an updated copy of your lesson plan, developed assessment tools, presentation materials, to the evaluator. See implementation plan instructions developed by the evaluator. Send within a week after completing the lesson to bonnie.swan@ucf.edu

RET Site: CoMET Lesson/Unit Plan

Course(s): Physical Science Honors, #2003320
Grade Level: Grade 8
Suggested Length of Lesson: 3 days

Materials/Technology Needed

- Tuning forks, dynamic microphone, piezo crystal(MEAS), oscilloscope, PIEZO FILM SENSORS WITHOUT LEAD (12), small hair dryer, string and soundboard of a guitar or violin, tuning fork, digital thermometer.

For video: Smartboard or projector
https://youtu.be/hSjmOsey0UA?t=59

Where this Fits: 1st Quarter- The Practice of Physical Science - 08/14/17 - 08/23/17

Lesson Objective(s)/Learning Goal(s)

- Design an experiment to detect and measure the resonance frequency of the vibrating string and soundboard of a guitar/ violin, tuning fork, or other musical instrument.
  - Design an experiment that will convert and measure acoustic/vibrations (mechanical energy) of a vibrating string and soundboard of a guitar or violin to electrical energy, using a microphone and oscilloscope; then compare the results when a piezo film sensor is attached directly to the device.

Based on OCPS Grades 9-12 - Physical Science Honors - #2003320 - Scope & Sequence 2017-2018
Standard(s)/Benchmark(s) Addressed

Standards:

- **SC.912.N.1.1 -** Define a problem based on a specific body of knowledge, pose questions about the natural world, conduct systematic observations, examine books and other sources of information to see what is already known, review what is known in light of empirical evidence, plan investigations, use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), pose answers, explanations, or descriptions of events, generate explanations that explicate or describe natural phenomena (inferences), use appropriate evidence and reasoning to justify these explanations to others, communicate results of scientific investigations, and evaluate the merits of the explanations produced by others. (Content Complexity Level 3)
- define science as a systematic process of investigation of observable phenomena using the scientific method
- relate what methods are used in scientific research
- define a problem based on Physical Science
- pose questions about the natural world using Physical Science
- review and discuss what is known in light of empirical evidence

Standards for Mathematical Practice

Instructional Strategies:5E Model of Instruction

- Engage- Quick Write- 5 min

Evidence of Learning (Assessment Plan)

- **Pre-and Post-test**

- **Student evidence should show that they can:**
- **research a problem based on a specific body of knowledge. (SC.912.N.1.1)**
- **develop a strategy to solve a scientific problem. (SC.912.N.1.1)**
- **use diagrams and models to represent and solve a scientific problem. (SC.912.N.1.1)**
- **explain ways in which a scientific problem can be solved. (SC.912.N.1.1)**
- **illustrate the use of different pieces of lab equipment and explain how they should be handled with proper safety procedures. (SC.912.N.1.1)**

- **define a problem based on a specific body of knowledge (physical science), pose questions about the natural world, conduct systematic observations, examine books and other sources of information to see what is already known, review what is known in light of empirical evidence, plan investigations, use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), pose answers, explanations, or descriptions of events, generate explanations that explicate or describe natural phenomena (inferences), use appropriate evidence and reasoning to justify these explanations to others, communicate results of scientific investigations, and evaluate the merits of the explanations produced by others. (SC.912.N.1.1)**

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- Explorer: YouTube video and article. Predicts and formulate hypotheses.
- Explain: In your own words
- Extend/Elaborate: Investigation and redesign experimental design.
- Evaluate: open-ended questions

Marzano's Learning Strategies:

DQ1: Providing Clear Learning Goals and Scales (Rubrics)
DQ4: Helping Students Generate and Test Hypotheses
21. Organizing Students for Cognitively Complex Tasks
22. Engaging Students in Cognitively Complex Tasks Involving Hypothesis Generation and Testing
23. Providing Resources and Guidance
NOTE: Although many of the elements from DQ 2 and 3 are used in this lesson, the predominant elements are from DQ 4; elements 21, 22, and 23.

Description of Lesson Activity/Experiences: This will be an open inquiry lab design.

1. **Engage-** Quick Write 5 min: Write everything you know about resonators and piezoelectric material/crystal, sensors, and resonant frequency.
2. **Explorer:** YouTube video on resonant frequency: After watching the video, add to your quick write, and come up with 2 inquiry-oriented questions to investigate resonant/natural frequency. Share your ides with your lab group. Each person gets a turn to share- positive criticism only.
3. **Explorer (2):** Read article on piezoelectric materials and resonators. Small group discussion and reflection. Modify your Quick Write. Formulate your hypothesis based on the lesson objective.
4. **Explain:** Explain your new understanding on resonators and resonance frequency, and piezoelectric material
5. **Extend/Elaborate:** apply/extend the new understanding by designing an investigation that will convert acoustic energy(vibrations) from a tuning fork or a vibrating string to electrical energy. Use a microphone & oscilloscope, then use a piezo film sensor & oscilloscope attached directly to the tuning fork. Then compare the results of the two experiments. WRITE YOUR CONCLUSION.
    - **Formal Lab Report-see attachment.**

    EXTEND PART B: Now students will apply their new knowledge by designing another Lab that will test the effects of temperature on resonance frequency using a **PIEZO FILM SENSOR** and an oscilloscope. Essentially, students will be designing an experiment in which they use a piezo film as a temperature sensor.
6. Evaluate: assessment through open-ended questions- post test

Recommended Assessment(s) and Steps

1. Pre-assessment Quiz
2. Quick Write-5 minutes
3. Pair share/small group discussion
4. Whole class discussion
5. Small group discussion after reading the article
6. Modify quick write after small group discussion-add to you answer
7. Formulate investigative question and hypothesis. Write step by step detailed procedures. This step must be approved by teacher before students can begin the experiment. Follow **Formal Lab Report Guide-see attachment.**
8. Conduct experiment
9. Modify and edit experiment based on teacher/peer feedback.
10. Conduct **Part B** of the experiment:" Effects on Temperature on Resonance Frequency"

List of Materials/Resources Used

- OCPS Curriculum Guide: Grades 9-12 - Physical Science Honors - #2003320 - Scope & Sequence 2017-2018
- Marzano Art and Science of Teaching Framework Learning Map
- YouTube https://youtu.be/hSjmOsey0UA?t=59
- **BSCS 5E Instructional Mode**

Important Vocabulary

Define unusual or probably unknown words. Write definitions in sentence format.

Term	Definition
Piezoelectric material-	Piezoelectric material are materials that can create electrical energy when subjected to mechanical stress.
Resonance frequency-	Resonance frequency is a natural **frequency** of vibration determined by the physical parameters of the vibrating object.
Resonator-	A **resonator** is a device or system that exhibits resonance or resonant behavior, that is, it naturally oscillates at some frequencies, called its resonant frequencies.
Sensor-	A sensor is a device that detects or measures a physical property and records, indicates, or otherwise responds to it.
Oscilloscope	An Oscilloscope is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional plot of one or more signals as a function of time. Other signals (such as sound or vibration) can be converted to voltages and displayed.
Mechanical energy	**Mechanical energy** is the sum of kinetic and potential **energy** in an object that is used to do work. In other words, it is **energy** in an object due to its motion or position, or both.
Electrical energy	The movement of charged particle through a wire or other device

Formal Lab Report Guideline PHY SCI HON Jn-Baptiste

I. **Essential/Testable Question:** A question that can be tested through experimentation and design ***(10 pts)***

II. **Hypothesis:** is a proposed explanation for a phenomenon (observed occurrence). ***(10 pts)***

~I.D. independent (test) and dependent (outcome) variables

III. **Materials and Methods:** ***(10 pts*)**

List materials:

Methods/Procedure: should be step by step, detailed, and easy to follow. Any safety cautions should be addressed here.

IV. **Results/Data:** ***(20pts)***

Data table and graph (title, x and y axis labeled, key if needed)

- When writing your conclusion, you need to think about the following:
  - What trends/patterns did you observe?
  - What questions were raised after you analyzed the data?
  - How does the data you collected relate to what you originally hypothesized?
  - If the data you collect was not what you expected, does that mean the results were incorrect?
  - How might you modify the design of the experiment for future trials?
  - Your conclusion paragraphs should show continuity throughout.

V. **Conclusion: 50 pts**

- **Introduction:** main objective(s)/purpose of lab. Restate your hypothesis. Was your hypothesis supported; refer back to your data.
- **Methods:** a quick description of the procedure.
- **Results:** statement of the overall findings. Give data/observations to support your answer. Analyze the data.
- **Outcome:** what you learned about the scientific concept.
- **Discussion/Reflection:** Explain why you think you got these results. Discuss any errors that may have occurred during the experiment. If you did this experiment again what changes would you make to improve it? Every lab can be improved! Any real-life applications?
- **Reference:** if your research was based on someone else's work or if you cited facts that require documentation, then you should list the references.

Troubleshooting Tips

Add anything helpful here.

Other Helpful Information

Add anything helpful here.
Acknowledgement and Thanks:
I would like to thank Dr. Reza Abdolvand and his graduate students Sarah Shahraeeni and Hakhamanesh Mansoorzare for their insight and knowledge on MEMS Resonators.

Attachments

List here any lesson or activity attachments not included within this document, such as the following:

- PowerPoints for lecture
- Handouts (Worksheets, Activities, Quizzes, Visual Aids, etc).

  https://youtu.be/hSjmOsey0UA?t=59
- Answer Keys
- Coding

Remember to send these as separate files along with your unit/lesson plan.

References

List here using APA format

1. **(n.d.). Retrieved from Https://youtu.be/hSjmOsey0UA?t=59. N.p., n.d. Web**
2. **(n.d.). Retrieved from** https://bscs.org/bscs-5e-instructional-model
3. (n.d.). Retrieved from http://education.ucf.edu/rtp3/docs/RTP_Marzano_Art%20_Science_of_Teaching_Framework.pdf

Acknowledgements

Authors

Junior Jn-Baptiste,
List your name first, along with anyone who helped you (grad student, etc.) here

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