Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

Course Number: Course Name

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2001320 Earth Space Science Honors

7/13/2019

READ THIS FIRST

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RET Site: Ocean Acidification Lesson/Unit Plan

Subject Area(s): Science
Course(s): Earth Space Science Honors
Grade Level: 7th
Suggested Length of Lesson: 5 (45- minute) class sessions

Lesson Summary: Students will be able to carry out a scientific investigation on ocean acidification and apply their understanding of the carbon cycle, Earth's spheres and the oceans impact on our climate.

Prerequisite Knowledge:
SC.7.N.1.1: Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
SC.7.N.1.3: Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.
SC.7.E.6.6: Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

Materials/Technology Needed
- **pH Probes**
- **GlobiLab Software**
- **Laptop**
- **Scratch**
- **Glass Beakers**
- **Saltwater, Freshwater & Acetic Acid**
- **Digital Scales**
- **Seashells or other calcium bicarbonate item (chalk or tums)**

Where this Fits/Lesson Dependency
Units where this lesson can be incorporated include, but is not limited to:
- **Carbon Cycle**
- **Interactions of Earth's Spheres**
- **Nature of Science**
- **Ocean impact on Climate Change**
- **Human Impact**

Lesson Objective(s)/Learning Goal(s) (2-4)
- Students will be able to cite evidence that the ocean has an influence on the climate change by absorbing and storing carbon.
- Students can analyze the movement of matter and energy through the carbon cycle.

Standard(s)/Benchmark(s) Addressed (2-4)
SC.912.E.7.9 - Cite evidence that the ocean has had a significant influence on climate change by absorbing, storing, and moving heat, carbon, and water.

SC.912.E.7.7 - Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change.

SC.912.N.4.2 - Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental.

SC.912.E.7.1 - Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

Standards for Mathematical Practice	**Instructional Strategies**
MAFS.912.F-IF.2.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship	▪ Hands-on Activities ▪ Experiments ▪ Graphic Organizers ▪ Scaffolding Instruction ▪ Modeling ▪ Cooperative Learning Strategies
Evidence of Learning (Assessment Plan) ▪ Pre-Assessment ▪ Lab Reports ▪ Formative Assessments ▪ Summative Post-Assessment	

Description of Lesson Activity/Experiences

Part 1: Disappearing Shells

(This lab was adapted from Anna McPherson at the Materials Research Laboratory at UCSB.)

Introduction Activity: (Inquiry-Based Activity)

Students watch a short video on Ocean Acidification. Students are assigned a number, which correlates with a question from the video. At the end of the video students participate in a timed round robin to share what they have learned.

Video Discussions Questions:

1. What is happening to the coral reefs in the Florida Keys?
2. What is causing these changes?
3. What is ocean acidification?
4. How does this impact the marine ecosystem, humans & Florida?

Disappearing Shells Lab:

Lab Procedure:

Students will be divided into groups of 4 to complete the lab activity.

Students put 200 mL of salt water, salt water & acetic acid, and acetic acid in separate beakers.

Students measure the pH of the salt water, salt water & acetic acid, and acetic acid and the mass of the seashells.

Students place a seashell in salt water, salt water & acetic acid, and acetic acid.

Students record qualitative and quantitative data.

Students make a prediction about the outcome.

Students will complete a quick survey about their prediction & level of understanding on content (pre-assessment).

Students remove the sea-shells and record observations.

Students will answer the data analysis questions as a group.

Students will complete a summary of learning Exit Ticket.

Research: Close Read Article

Students will complete a close read an article on Ocean Acidification (Florida's Coral Reefs)

Part 2: Cycling Carbon

Students log into a Nearpod Lesson on the Carbon cycle and watch video on Carbon Cycle to complete an interactive matching activity on new vocabulary.

Students use and interactive carbon cycle diagram to complete a card sort activity on whether carbon is being added, removed or stored.

Students complete the Carbon Cycle Journey activity and complete the record sheet.

Students will take a Quiz on the Carbon Cycle.

Part 3: *Ocean Acidification (pH & CO2 Lab)*

Students complete a Nearpod Lesson on Ocean Acidification.

Students complete an experiment to test the effect of CO2 on the pH of freshwater and saltwater.

Lab Procedure:

Students will use a straw to add CO2 to 200 mL of freshwater for 1 minute

Students will measure the pH change with a pH probe and record on data table

Students will add more CO2 to 200 mL of freshwater for 2 minutes, 3 minutes & 4 minutes

Students will measure the pH change with a pH probe and record on data table

Students will repeat the same steps with 200 mL of saltwater.

Data Analysis & Conclusion

Students will graph data using Google sheets

Students will analyze data by answering the data analysis questions

Students will write a conclusion to include their collected data results, the impact of ocean pH on Florida's Coral Reef systems, carbon cycle, and ways to reduce anthropogenic carbon dioxide.

Part 4: *Technology in Science* solving a societal/environmental problem

Students will learn about the sensor technology and communications used in the study of Ocean Acidification by completing a Nearpod lesson.

Students will write a code with Scratch that can use pH data collected by the sensor to determine if pH of the water is at a safe level.

Sample: https://scratch.mit.edu/projects/317999706

Recommended Assessment(s) and Steps

- Pre-Assessment given prior to introducing the lessons.
- Lab reports are used to help with analyzing data and summarizing their understanding of the content.
- Formative Assessment Options: Discussion Questions, Interactive Nearpod lesson, Embedded Quizzes, Text Rendering, Short Photo Summary, Bellwork Questions, Exit Tickets, Polls
- Summative Post-Assessment given at the end of the lessons.

List of Materials/Resources Used

Ocean Acidification Research Sources:

- https://oceanservice.noaa.gov/facts/acidification.html
- ttps://serc.carleton.edu/eslabs/carbon/7a.html
- https://secoora.org/new-acidification-sensors-added-to-a-buoy-in-the-gulf-of-mexico/
- https://www.pmel.noaa.gov/co2/story/Cheeca+Rocks
- https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification

Engineering Connection (60-100 words/3 sentences)
The students will solve the problem to determine if the pH of the ocean water is safe for the sea life. Students will work in teams to create a pH indicator using the pH data collected in the lab. They will develop Scratch code designed to determine if the water is safe based on the pH data collected. Students will need to continue to brainstorm and make improvements to the code so that it works properly and communicates the information clearly to the end user.

Engineering Category (choose one)

x	relating science and/or math concepts to engineering (primarily science & math with some engineering)
	engineering analysis or partial design (primarily engineering with some science/math)
	engineering design process (full engineering design)

Key Words
Atmosphere, Hydrosphere, Biosphere, Ocean Acidification, Carbon Cycle, Matter, Energy, Biogeochemical Cycles, pH, Greenhouse gases, Upwelling. Fossil Fuels, Carbonic Acid, Calcium Carbonate

Introduction/Motivation (written as if talking to students)

What is the greenhouse effect? ***Student response…..*** **Awesome, some of the gasses in Earth's atmosphere like Carbon Dioxide and Methane trap heat so it can't escape. Where does the Carbon Dioxide and Methane come from?** ***Student response…..*** **That's right! Much of this carbon dioxide is the result of humans burning fossil fuels, like coal, gasoline...**

So do you know where this extra Carbon Dioxide goes? ***Student response…..***

Did you know that the ocean soaks up more than one-quarter of the greenhouse gas that has built up in the atmosphere? If not for that great feature of the ocean, temperatures would be must higher and even more of Earth's sea ice and glaciers would have melted. Also, the increase of Carbon Dioxide in the past 200 years, has caused our oceans to be more acidic.

So in this unit we will be learning about the relationship between the Carbon Cycle, Climate, Oceans and the Environmental impacts if they are not in balance.

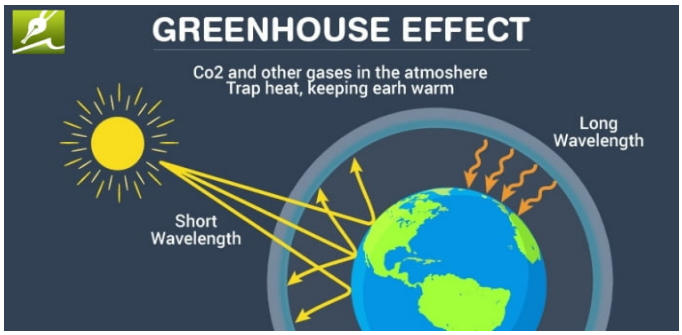
Lesson Closure (written as if talking to students)

At this point you should be able to cite evidence that the ocean has a significant influence on the climate by absorbing, storing and moving heat, carbon and water. Ocean Acidification is evidence of the ocean's impact on Earth's ecosystems and climate. Also, it is important to understand the relationship between Earth's oceans, the carbon cycle and the effects if the system is not in balance. All of this has an impact on humans, economics and the environment and we need to develop solutions for solving these problems, so that we can continue to enjoy the biodiversity of life on this planet.

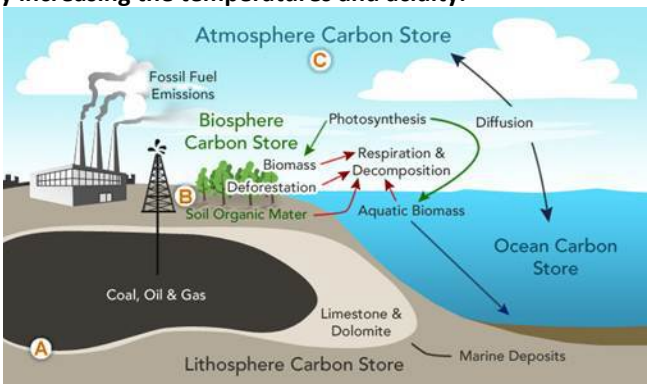
Lesson Background & Concepts for Teachers

Teachers need to understand the following concepts:

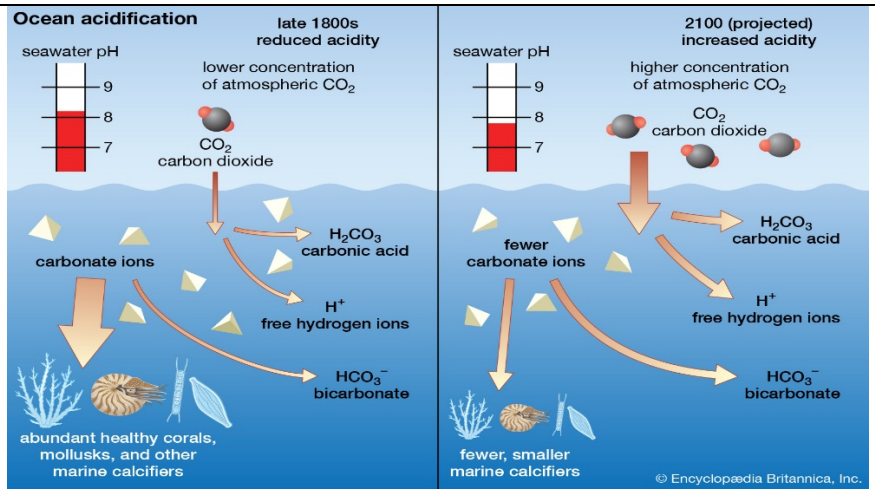
Greenhouse Effect: The increase in Earth's temperatures due to heat trapping gasses in the atmosphere. The increase in Carbon Dioxide and Methane are related to human activity through the use of fossil fuels, agriculture practices, and waste in landfills.



Carbon Cycle: The carbon cycle demonstrates the movement of carbon through Earth's systems. The oceans are an important part of the carbon cycle and store much of the excess carbon emitted into the atmosphere. This impacts the oceans by increasing the temperatures and acidity.



Ocean Acidification: This occurs due to a decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide from the atmosphere. Acidification can affect many marine organisms, but especially those that build their shells and skeletons from calcium carbonate, such as corals, oysters, clams, mussels, snails, and phytoplankton and zooplankton, the tiny plants and animals that form the base of the marine food web. These "marine calcifiers" face two potential threats associated with ocean acidification:
1) Their shells and skeletons may dissolve more readily as ocean pH decreases.
2) There are fewer carbonate ions, the primary building blocks for shells and skeletons.
Marine organisms that build shells or skeletons usually do so through a chemical process that converts bicarbonate to carbonate in order to form calcium carbonate.



Socio-Economic Impacts of Ocean Acidification on Florida's Coral Reefs:
Coral Reefs act as a habitat and nursery for commercial fish stocks, provide natural barriers for coastlines and tourism opportunities. Florida has a $2.7 billion coastal economy, which his highly tied to coral reefs. Tourism is responsible for more than half the jobs in the Florida Keys (dive shops, charters, seafood restaurants…) and Monroe County is the 10th most valuable fishery in the United States bringing in seafood worth $71.2 million.

Important Vocabulary

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

Term	Definition
Atmosphere	*The envelope of gases surrounding the earth or another planet.*
Hydrosphere	*All the waters on the earth's surface, such as lakes and seas, and sometimes including water over the earth's surface, such as clouds.*
Biosphere	*All living organisms, such as trees, birds and fish.*
Ocean Acidification	*The ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere.*
Carbon Cycle	*The cycle of carbon in living things in which carbon dioxide is used in photosynthesis to form food and growth substances and is later returned to the environment by respiration, decay, and burning*
Matter	*Any substance which has mass and occupies space. All physical objects are composed of matter, in the form of atoms, which are in turn composed of protons, neutrons, and electrons.*
Energy	*Energy, in physics, the capacity for doing work. It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms.*
Biogeochemical Cycles	*A pathway by which a chemical substance moves through biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth. Examples: Carbon Cycle or Water cycle*
pH	*Is a measure of hydrogen ion concentration, a measure of the acidity or alkalinity of a solution. The pH scale usually ranges from 0 to 14.*
Greenhouse Effect	*The process that occurs when gases in Earth's atmosphere trap the Sun's heat.*

Upwelling	*A process in which deep, cold water rises toward the surface.*
Calcification	*Is the process by which marine organisms such as oysters and clams form calcium carbonate. Seawater is full of dissolved compounds, ions and nutrients that organisms can utilize for energy and, in the case of calcification, to build shells and outer structures.*

Troubleshooting Tips

When setting up the Ocean Acidification lab make sure the beaker is no more than half full due to splashing caused by blowing CO2 into the beaker and the use of smoothie straws is more effective at adding CO2 to the water. Also, remember to calibrate the pH probes prior to use in the lab.

When using Scratch make sure students make their projects public and disable comments. This will allow you to access the student's projects.

Other Helpful Information

The pH probe does not need to be Globilab, any type of pH probe or sensor can be used for this type of activity.

If seashells are not available you can use chalk or Tums (calcium carbonate) tablets instead.

Nearpod allows teachers to share live lessons synced to all student devices. It creates interactive lessons with real time feedback of student understanding.

Attachments

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

- Disappearing Seashells Inquiry Lab Sheet
- Carbon Cycle Game and Carbon Cycle Journey Sheet
- Interactive Carbon Cycle:

  http://static.lawrencehallofscience.org/mare-sims/2-7-interactive-carbon-cycle-diagram.html

  https://www.sciencelearn.org.nz/image_maps/3-carbon-cycle
- Ocean Acidification Lab Sheet
- Scratch Sample Code
- Nearpod Links:

  Carbon Cycle: https://share.nearpod.com/7hQ3cy7nqY

Pre & Post Assessment:

https://docs.google.com/forms/d/e/1FAIpQLSfcFmeGA4LCKQc_OD5fcFc8BEARgNdjqwElluj0dRBZhQhmpA/viewform?usp=sf_link

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

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