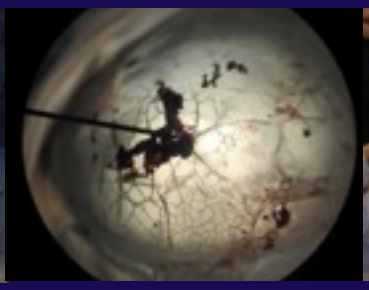
Examples of Interdisciplinary Teaching and Learning
through the STEAM Lens

January 24, 2014 , Amy Holt Cline

Implementing Interdisciplinary methods in traditional subjects.

Teaching science through using art, technology, engineering and math has given students unique opportunities to demonstrate understanding of old topics in new ways. This newsletter will explain a few different STEAM-focused units taught within 9th grade Biology classes and 8th grade Design Science Lab classes at AIM Academy.

Teaching Science at AIM Academy is a creative,engaging and experimental endeavor. The school serves students with learning differences though an arts-based methodology. Their mission is to: “Provide extraordinary educational opportunities to children with language-based learning disabilities such as dyslexia, dysgraphia, and dyscalculia, utilizing research-based intervention strategies and an arts-based learning environment that is college preparatory in scope and sequence”. www.aimpa.org

The units discussed in this newsletter represent several different projects that were taught over the course of 1or 2 years. STEAM subjects and interdisciplinary methods are used constantly at AIM Academy. This packet represents a sampling of units that have been tested with students using the STEAM philosophy. Not every subject within STEAM is taught within every single unit. Although, the author has found that STEAM is a great way to think about teaching a wider range of mental and physical thinking skills.

Amy Holt Cline is a Visual Science Teacher at AIM Academy. She and her colleagues are actively implementing new ways to teach old subjects. Inspired by Robert and Michelle Root-Bernstein’s research on the 13 Thinking Tools of the Most Creative People, Amy is working to provide hands-on lessons that teach students high level science content through a wide range of lessons and thinking skills.

STEAM Unit Topics: Biology and Design Science Lab

Design Science Lab 8th Grade

1. **Marine Phytoplankton**: 3D Models *(Science, Technology, Art/Design)*


2. **Bioluminescent Robots** *(Science, Technology, Engineering, Art/Design)*

3. **Makey Makey Circuit Boards** *(Science, Technology, Engineering, Art/Design)*


Biology 9th Grade

4. **Dendrology Unit**: Internal Anatomy of Trees- Hand built tree rings *(Science, Art/Design*

5. **Seafloor Interactions:** Submersibles, Benthic Habitats, Invertebrates, SeaPerch, HabCam *(Science, Technology, Engineering, Art/Design, Math)*

Other Interdisciplinary Projects Not Detailed

Makey Makey Music Tree: *(Technology, Engineering, Art/Design)*

Cartilaginous Fish: Visual Guide to Sharks *(Science, Technology, Art/Design)*

Evolution-Darwin: Google Earth *(Science, Technology, Art/Design)*

River Fish Watershed Study: *(Science, Art/Design)*

Ecosystem-Organism Relationship Migration: Cape May Field Guide *(Science, Technology, Art/Design)*

Taxonomy: Creature Cards *(Science, Technology, Art/Design)*

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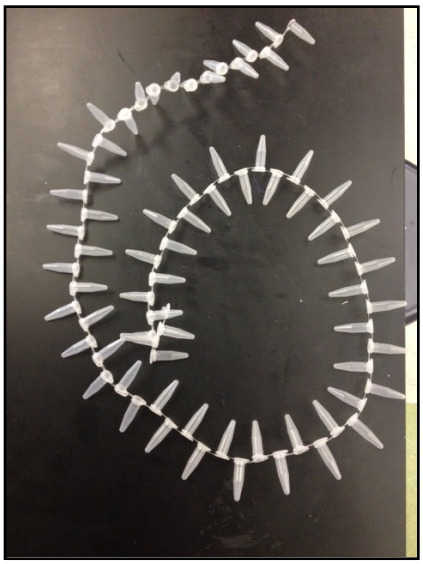
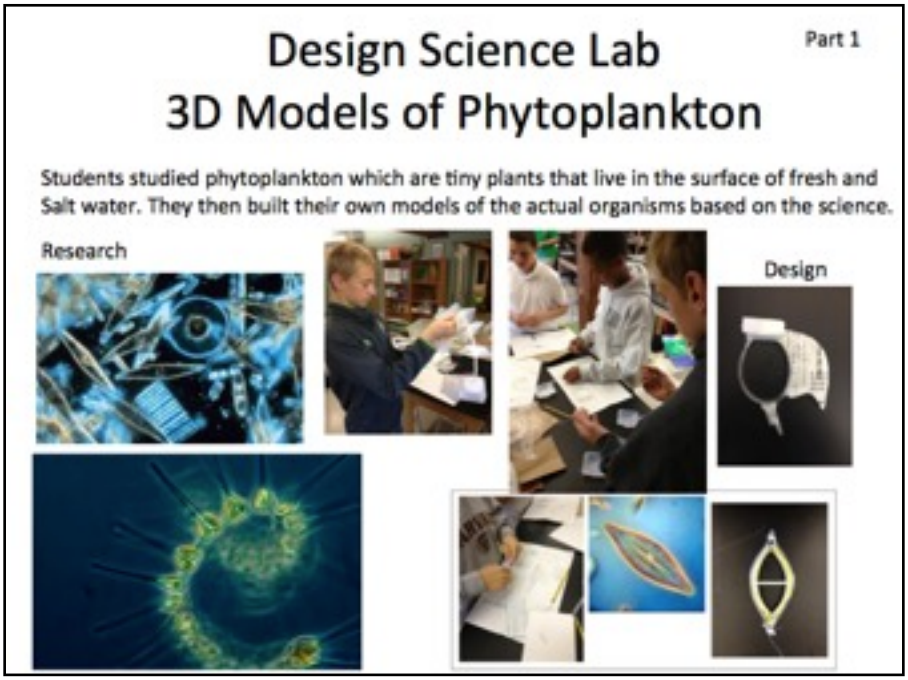
1. Marine Phytoplankton: 3D Models - Part 1

Design Science Lab 8th Grade

Merging Science and Art

The following project took place in an 8th grade, non-traditional science class called Design Science Lab. Students learned with and from a research scientist who focuses on phytoplankton while they built their own 3D models of the single celled organisms.





Lesson Overview

What: Students studied phytoplankton which are tiny plants that live in the surface of fresh and salt water habitats. After studying about how they work, students they then built their own models of the organisms based on the organisms anatomy and physiology. Throughout this project students collaborated with Dr. Tim Moore of the University of New Hampshire.

How: The materials that were used included left over lab materials that we had in excess.

- tubing
- plastic weigh boats
- hot glue and hot glue guns, reg. glue
- an iron to fuse plastic into new materials
- toothpicks
- thin and thick wire

Why: This project exposed students to marine phytoplankton which is a subject that many do not learn about until they take a college biology class. This unit asked students to research, draw, build, think abstractly, design, ask questions and more. Students learn to accept design feedback about their projects based on educated feedback from a working oceanographer.

Left: Student prototype of an algae bloom of *Alexandrium sp.*

Left Image Above: Students experimenting with new materials.
Right Image Above: Students diligently working with a clear vision.

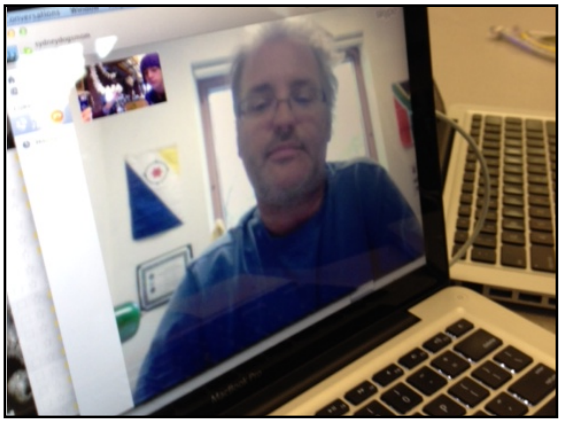
1. Marine Phytoplankton: 3D Models - Part 2

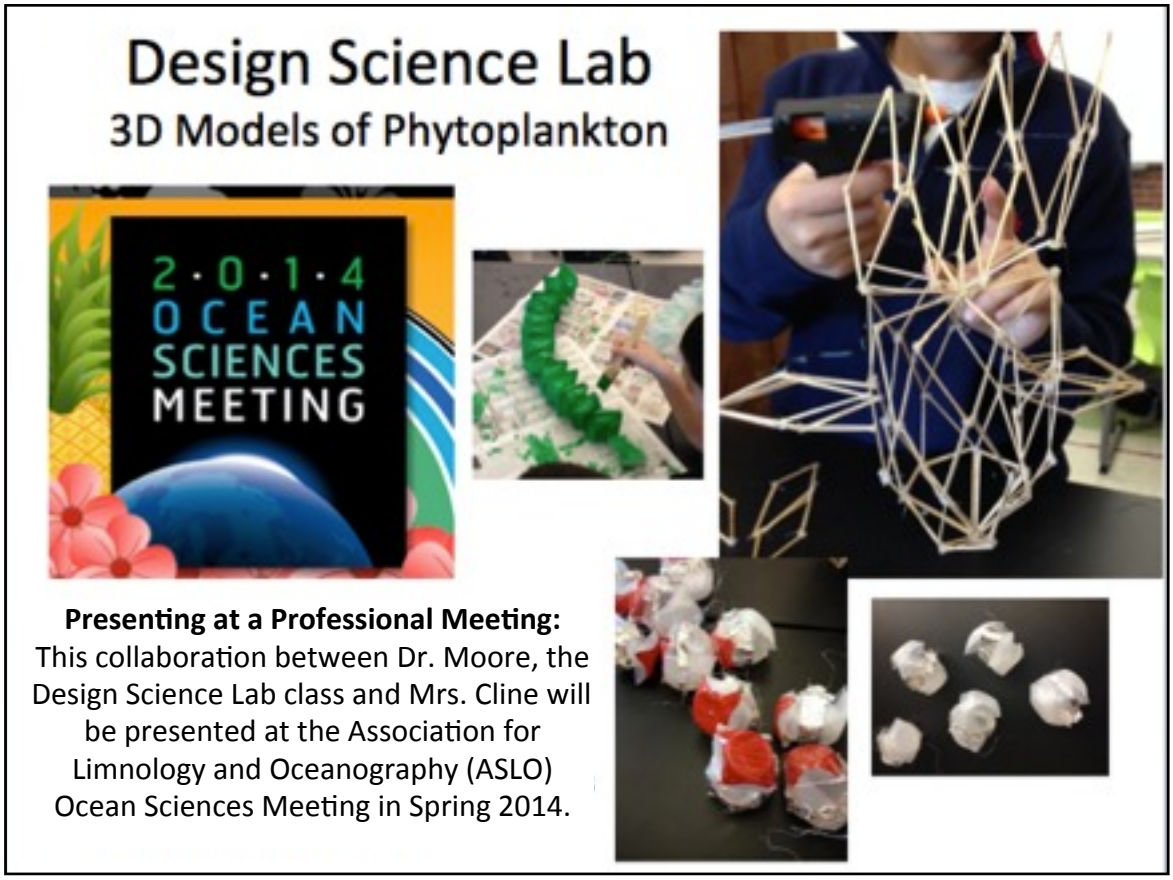
Design Science Lab 8th Grade

Collaborating with a Scientist

Students wrote letters, emailed and Skyped with Dr. Tim Moore, an oceanographer who studies phytoplankton and works at the University of New Hampshire. Dr. Moore gave students provided content through Skype, answered questions through email and provided multi-leveled feedback on their designs about how their models could be improved based on the anatomy and physiology of the actual organism.

Speaking with Dr. Tim Moore at the University of New Hampshire

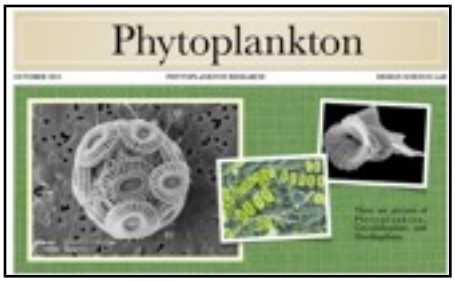




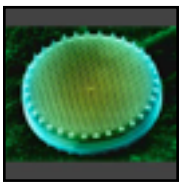
Presenting at a Professional Meeting: This collaboration between Dr. Moore, the Design Science Lab class and Mrs. Cline will be presented at the Association for Limnology and Oceanography (ASLO) Ocean Sciences Meeting in Spring 2014.

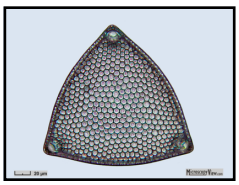
This unit taught students to:

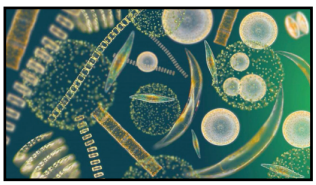
1. **Assimilate** high level science from a research scientist.
2. **Understand** the biology of such species as:
   a. *Coccolithophores*
   b. *Dinoflagelates*
   c. *Diatoms*
   d. *Cyanobacteria*
   e. *Dinophysis*
   f. *Alexandrium*
3. **Ask** questions and talk with a professional research scientist
4. **Design**, **Build** and edit their organism prototype



Left: Example of student plankton research project.







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2. Bioluminescent Robots

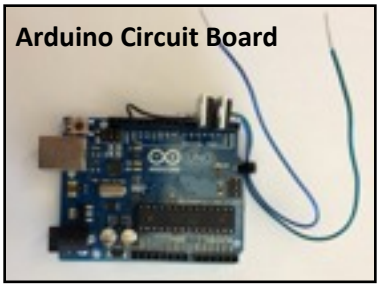
Make:

Design Science Lab 8th Grade

Design, program and engineering through the science of bioluminescence.

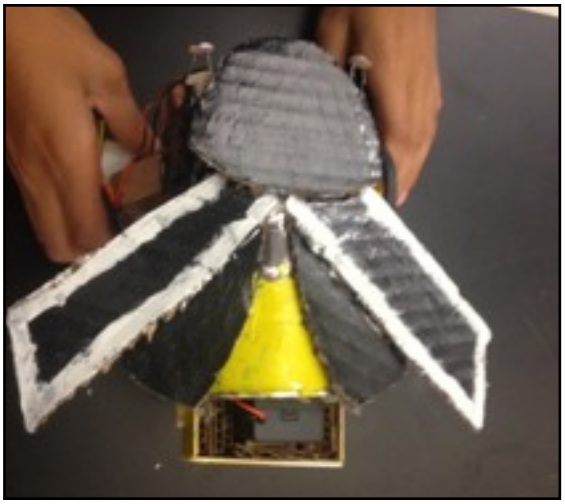
These bioluminescent robots were inspired by the CoffeeBot template featured in Make Magazine (http://makezine.com/projects/make-34/coffee-bots/). Using the Arduino circuit board, students were introduced to coding, design, soldering and the science behind how organisms respond to light in their natural environment.

Arduino Circuit Board

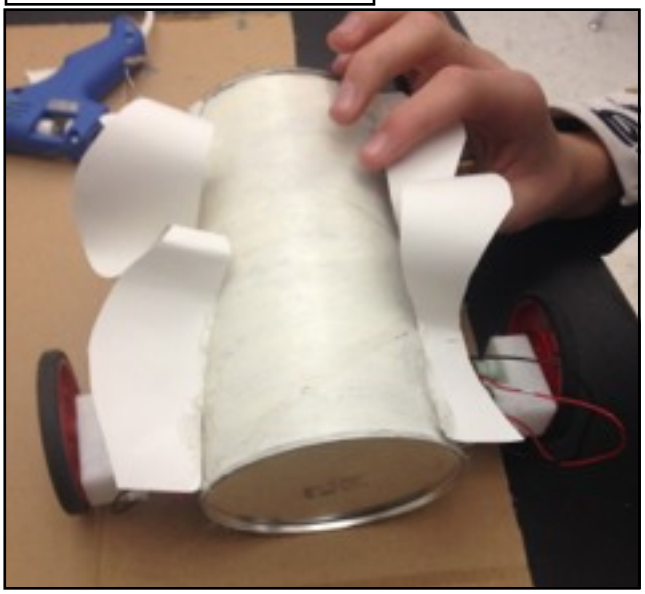


Below: Photoresistor which the robot uses to respond to light.

3D Prototype of a FireFly powered by Arduino



3D Prototype of a Cuttlefish



Lesson Overview

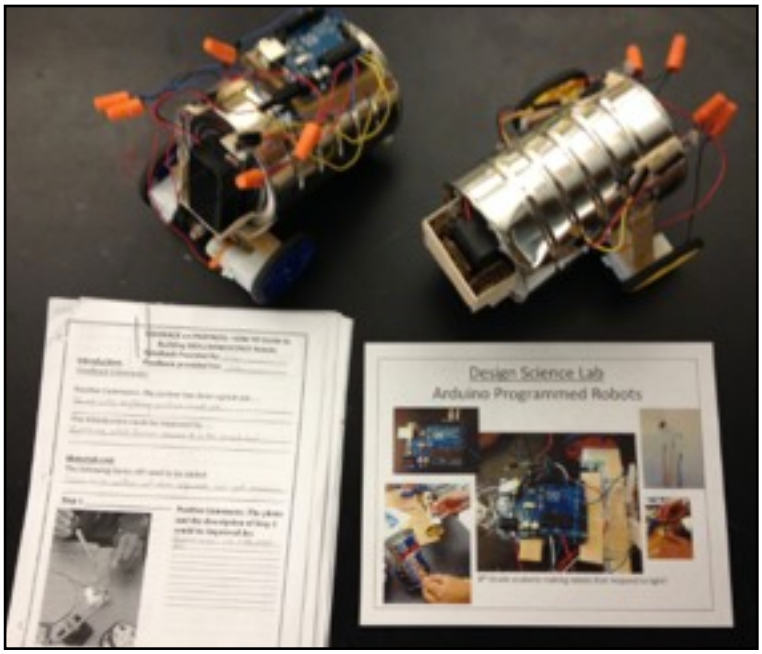
What: Students worked in small groups to create robots that responded to light by either going towards the light or running away from it. Students learned to solder wires to connect them to their motors and the circuit board. To document their process of making their robot, they made "How-To-Guides" similar to the format Make Magazine uses on their website.

How: The materials that were used included:

- coffee can
- wheels
- motors
- popsicle sticks
- hot glue
- arduino
- soldering iron, solder

Why: This project continued the content of bioluminescence which was discussed during the Phytoplankton unit. It also expanded their understanding of how animals communicate for survival as well as gave the a chance to improve their ability to collaborate with a partner through using the design process.

Below: Student Robots and How-To-Guides



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3. Makey Makey Circuit Board - Part 1

Design Science Lab 8th Grade

Teaching innovative thinking through imaginative and scenario based challenges. This unit introduces students to Makey Makey circuit boards and shows them that re-programming your keyboard is easier then expected.

Makey Makey Circuit Board

With simple wiring and a USB port, students can create almost anything!

www.makeymakey.com/

Above: Creating a PacMan Game using a graphite game board

Above and Left: Students testing their new hand made game board configuration.

Student using the scroll saw to prepare his project.

Lesson Overview

What: Students were asked to make 4 projects using the Makey Makey circuit boards.

Challenge Scenario 1. Access to Games - Re-assign your up, down, left, right arrow keys so that you can play a game without using the keyboard directly.

Challenge Scenario 2: Reprogram your keyboard to Make Music using either an online piano, drum set or other instrument.

Challenge Scenario 3: Create a game or music controller that can be played by someone who does not have any fingers.

Challenge Scenario 4: Make a Music Tree. Reworded this means, build a 3D prototype tree that stands on a table and if touched, will make harmonic music. This is a current project that is in a loose collaboration with the Newton North High School Greenengineer program.

How: The materials that were used included left over lab materials that we had in excess.

- tubing
- plastic weigh boats
- hot glue and hot glue guns, reg. glue
- thin and thick wire
- cardboard - lots
- left over foam pieces
- cardboard poster tubes
- scroll saw
- box cutters

Why: This project gave students a chance to work in smaller teams of 2 or 3, learn programming, think about how to convey musical sounds in new ways and to develop their abilities of design. Makey Makey circuit boards is a project created at MIT Media Lab's Lifelong Kindergarten. Additionally, this project is loosely collaborating with the Newton North High School Greenengineers Program who are building a large scale Music Tree using different technology. *Pictures on next page.*

3. Makey Makey Circuit Board - Part 2

Design Science Lab 8th Grade

Challenge in process

Challenge Scenario 4: Make an object that when touched makes music: example Music Tree. Students were asked to build a 3D prototype tree that stands on a table and if touched, will make harmonic music. Below are examples from AIM Academy's 8th grade class and the Newton North Greenengineer High School program.

Below: AIM Academy Music Tree using Makey Makey Circuit Boards.

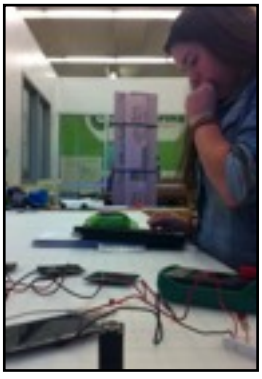
In process

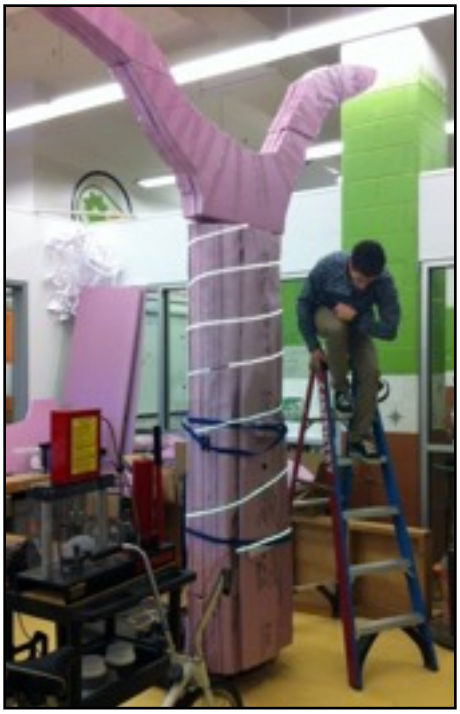
Students get experience working with their hands to create their ideas in 3D on a regular basis.

Right: Newton North High School Greenengineers Program - Music Tree.

In process

http://greengineers.wikispaces.com/





4. Dendrology Unit: *Internal Anatomy of Trees*

Biology 9th Grade

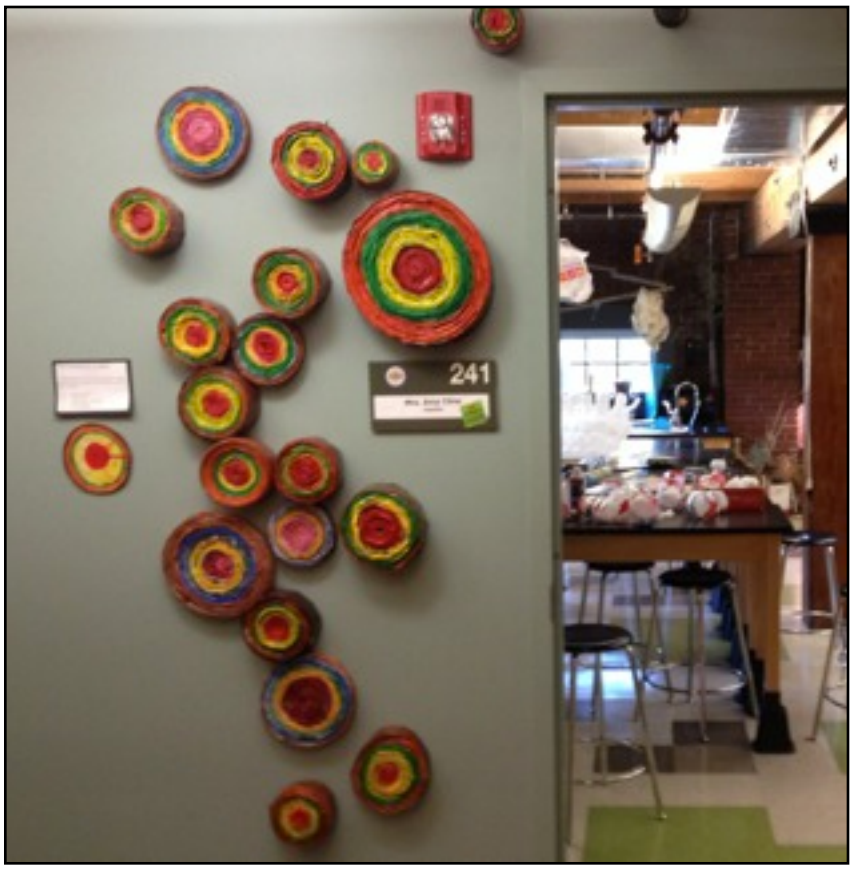
Understanding what we can not see.

This project helped students visualize, create and identify the internal anatomy of a tree. Students folded and rolled recycled paper and newspapers which were then painted to symbolize the thickness of each internal layer.

Student created tree rings Year 1

Key Terms:
1. Dendrology
2. Crown,
3. Roots,
4. Trunk Stem,
5. Heartwood,
6. Sapwood,
7. Cambium
8. Phloem
9. Xylem
10. Bark
11. Photosynthesis

Student created tree rings Year 2



Lesson Overview

What: As they learned about the subject of Dendrology, students created an herbarium of local trees, learned about the parts of the tree and then made tree rings of the internal anatomy of a tree. Students worked independently to fold, roll and paint each layer of a tree ring.

When: This project took place in a 9th grade Biology class

How: The materials that were used included.
- paper
- paint
- stapler, tape

Why: This project was nested within the fall tree unit. If timed correctly, this helps students understand how a tree works and where xylem and phloem are located in relation to the outer bark.

Subjects Featured: Science, Art and Design,
Thinking skills: Visualizing, Abstracting, Forming Patterns, Modeling

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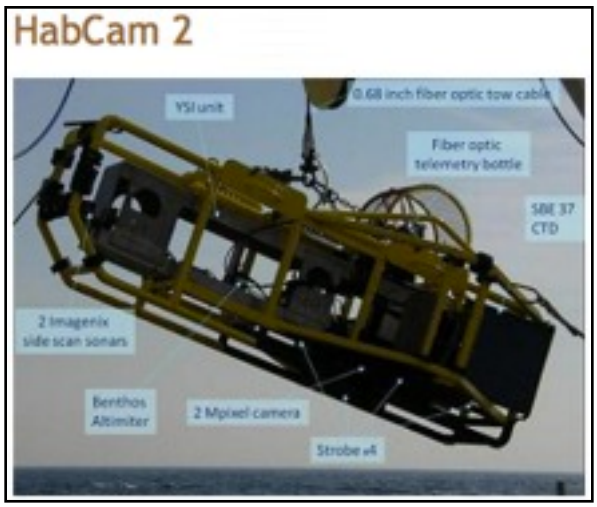
5. Biology: *Studying Seafloor Interactions* - Part 1

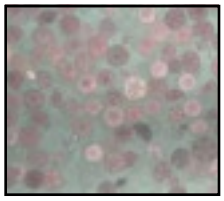
Biology 9th Grade

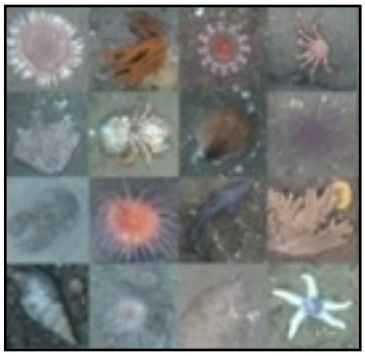
Engaging, thematic, multi-subject unit.

This unit teaches several different aspects of what it is like to study science on the bottom of the ocean. Students learn about submersibles, the HabCam research project based at the Woods Hole Oceanographic Institution in Massachusetts. They study benthic habitats and invertebrate biodiversity in the Gulf of Maine through analyzing high resolution images of the sea floor and build their own underwater robot with the SeaPerch program. *Continued on next page.*

Right: HabCam camera system and a few examples of the organisms that live on the sea floor in the Gulf of Maine.







Lesson Overview

What: This unit taught students about the following subjects:

- invertebrate species that thrive on the sea floor;
- bathymetric maps,
- submersibles used in scientific research
- engineering their own underwater robot
- interacted with scientists at work

How: The materials that were used included.

- SeaPerch Submersible Kits
- cardboard for maps
- paint, paint brushes
- exacto knives, glue,
- HabCam Seafloor Images
- Websites:
  - HabCam - http://habcam.whoi.edu/
  - SeaPerch - http://www.seaperch.org
  - NOAA - http://oceanexplorer.noaa.gov/technology/subs/subs.html

Why: This project taught students about:

1. Different types of Underwater Technology
2. HabCam - (Habitat Camera system)
3. How to analyze seafloor images
4. Jobs professional scientists have
5. Biodiversity of benthic macro invertebrates
6. How to build an underwater submersible called Sea Perch
   a. how to solder, cut PVC, collaborate, test for neutral buoyancy,
   b. how to work as a group
   c. and much more

Subjects Featured: Science, Technology, Art and Design, Engineering, Math

Thinking skills: Visualizing, Abstracting, Forming Patterns, Modeling, Dimensional Thinking, Imaging.

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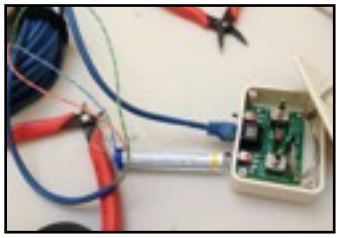
5. Biology: *Studying Seafloor Interactions* - Part 2

Biology 9th Grade

Engineering Underwater Robots

Below are a series of images showing students building their SeaPerch underwater submersibles. Working in teams, they studied famous oceanographic submersibles and then learned to cut, construct, connect, design and solder their own remote controls for their submersible. At the end students presented their work as engineers to a panel of judges.



Building, Soldering, Presenting

Famous Oceanographic Submersibles

Students created their own renderings of sea floor organisms inspired by the actual sea floor image taken by the Habitat Camera system.

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