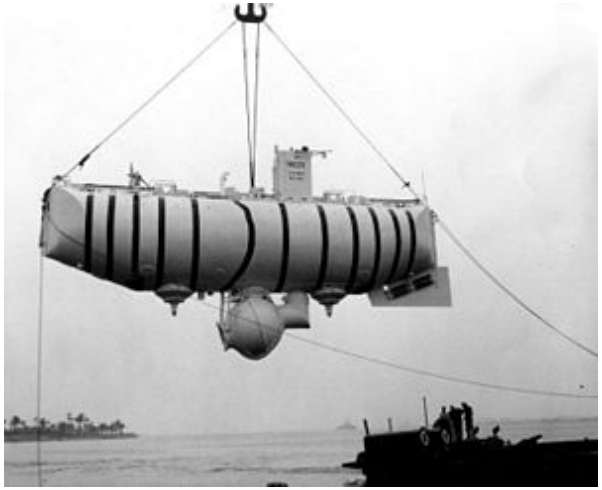
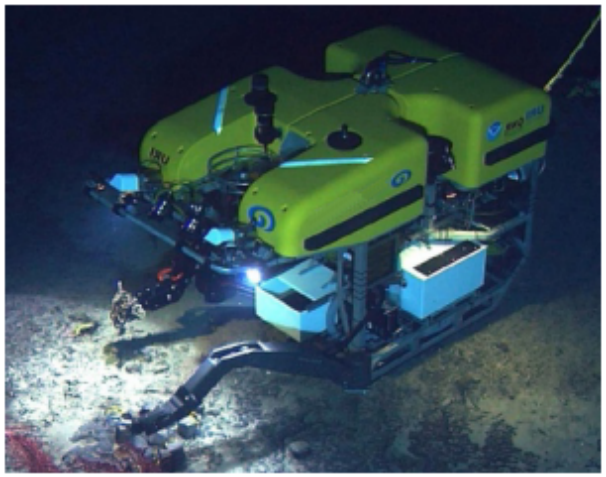




Using Marine Science Technology in an Integrated Science Class

By Jessica Thompson

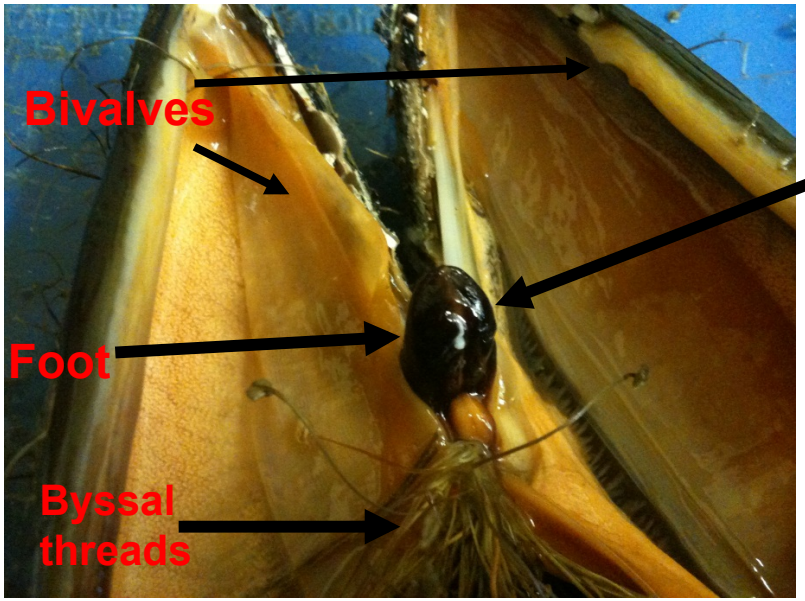
An Inquiry Adventure in Undersea Exploration Technology

RET I: Antimicrobial Properties of Mussel Foot Proteins in the Adhesive Plaques of California Mussels

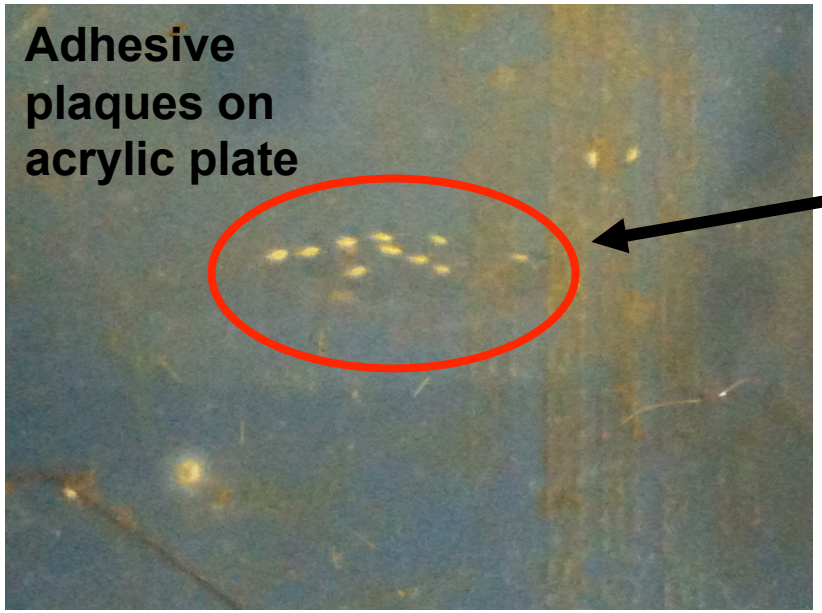
- Waite Lab: Using biomimetics to design under water adhesives

- To determine if proteins Mcfp-3-5 or-6, found in adhesive plaques of *Mytilus californianus*, have any antimicrobial activity.
- If the proteins do have antimicrobial activity, the biomimetic materials created from them could resist biodegredation.
- Biomimetic materials include adhesives that can be applied under water.

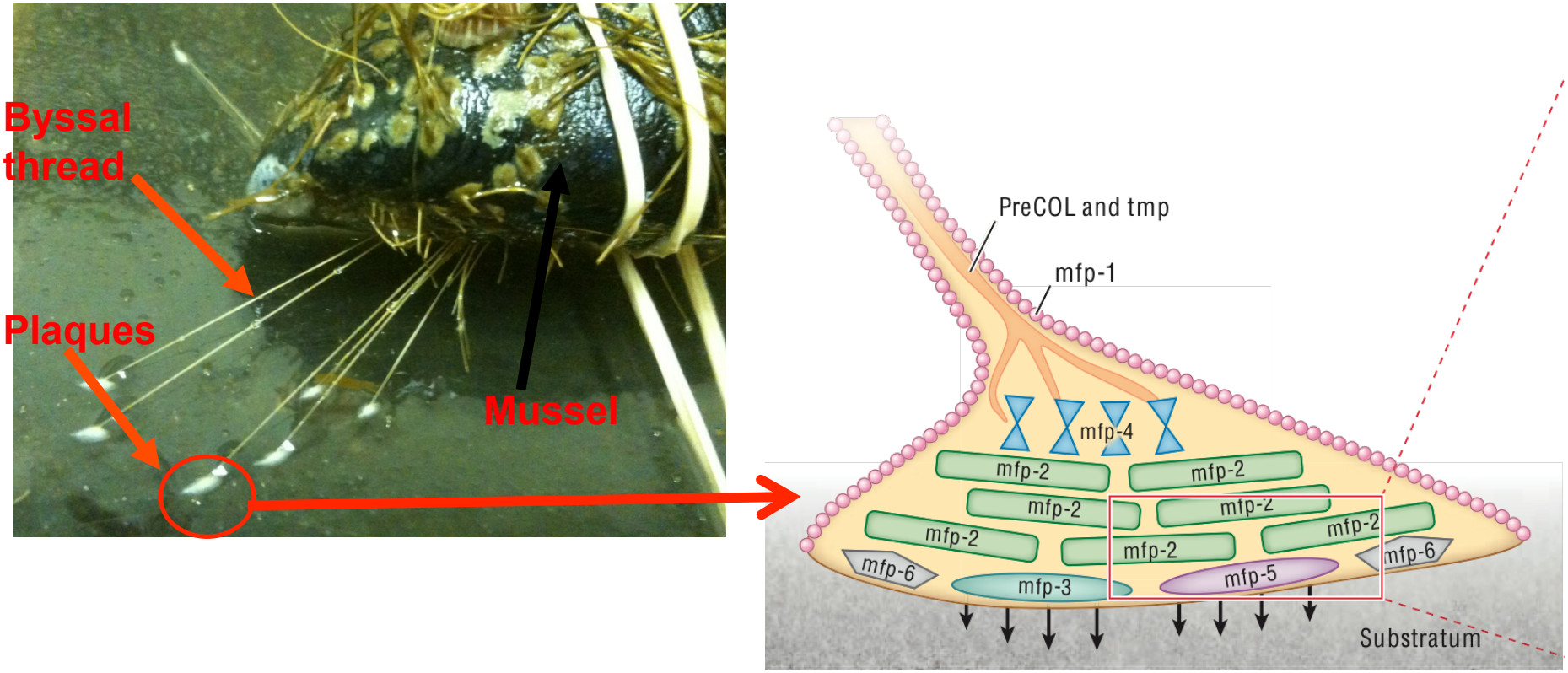
What is a Mussel's Adhesive Plaque?



Inside the mussel shell, there is a muscular foot which produces a thread and a plaque.



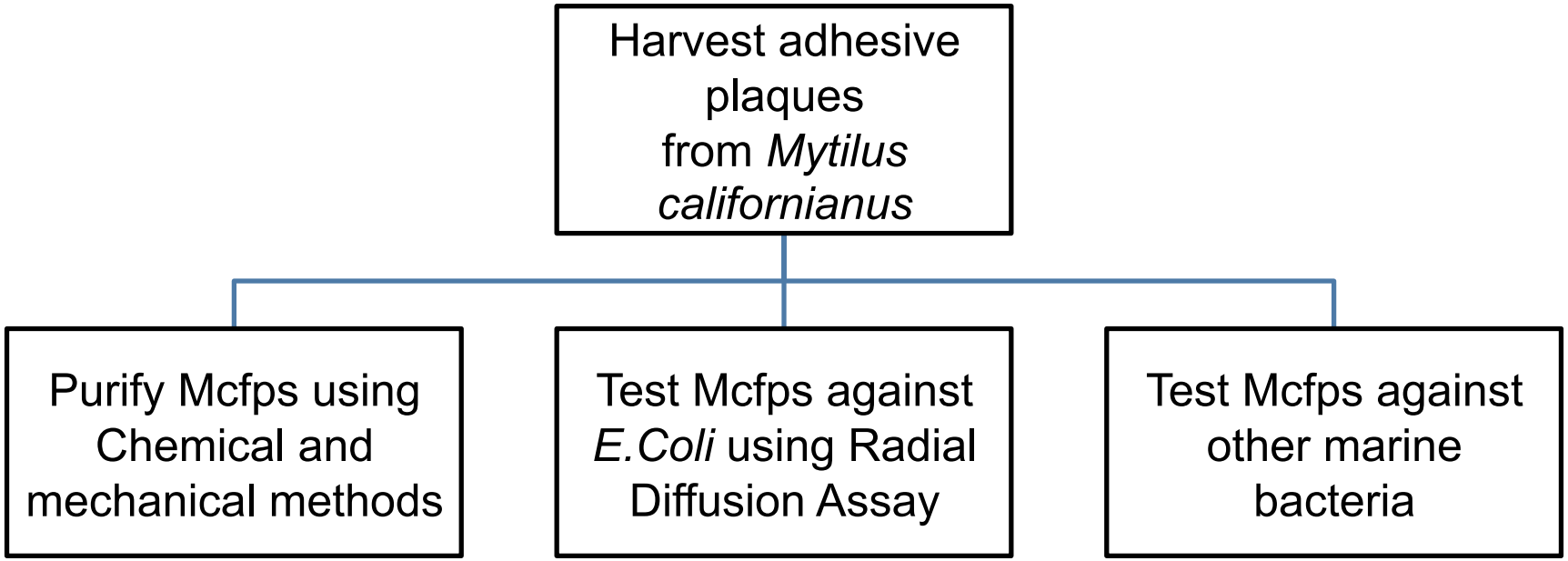
The plaques help the animal to adhere to rocks and other substrata in its intertidal environment so it is not swept away by waves.



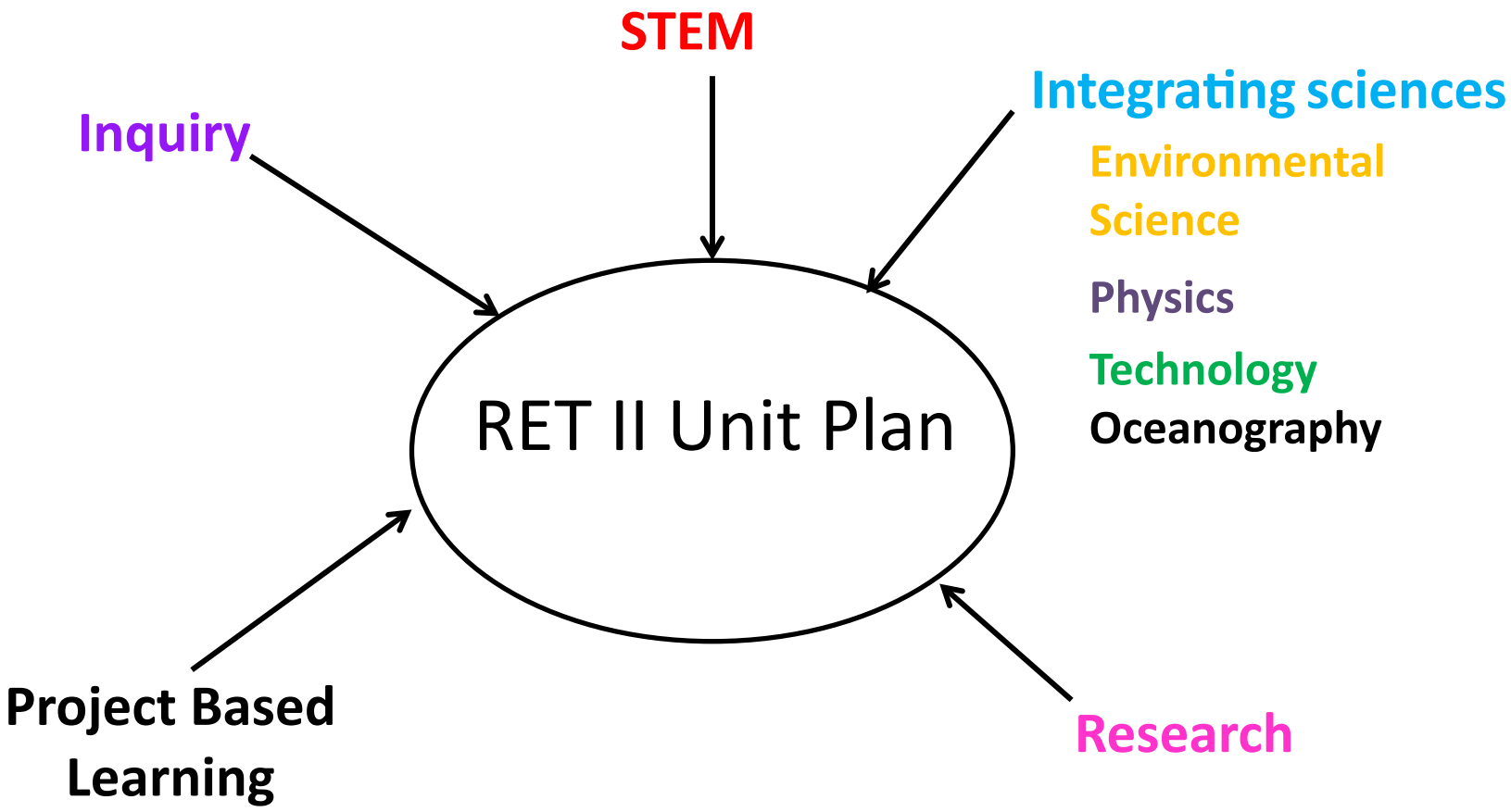
- This is an illustration of the mussel foot proteins (mfps) in an adhesive plaque of a marine mussel depicting the relative locations of the major proteins.

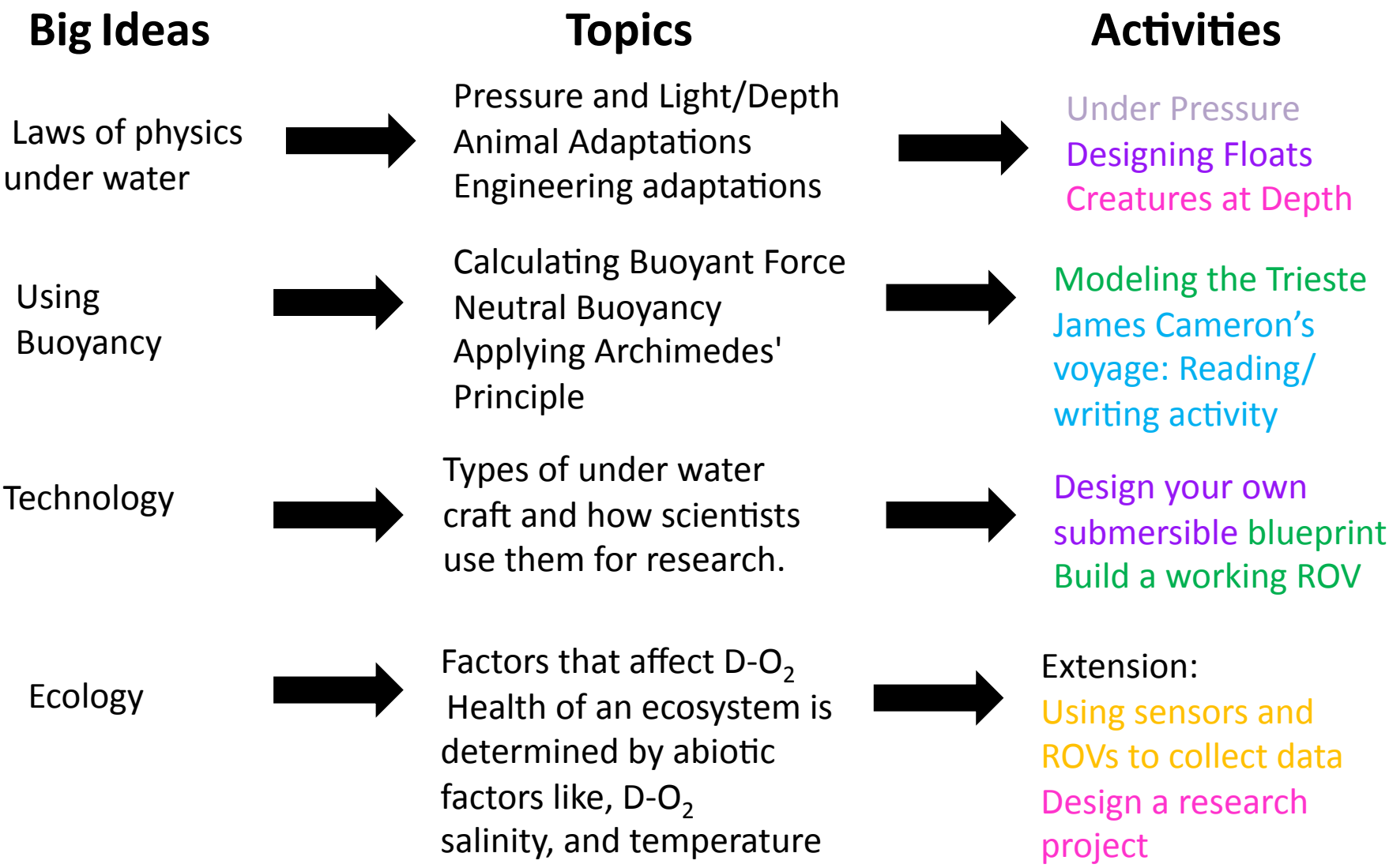
  (Adapted from Lee et. al. 2011[31])

Experimental approach



- Refined and refreshed lab skills
- Worked with current biotechnology used in protein extraction methods.
- Allowed me to put the labs I do with students into a professional context.
- Immersed in current research projects which I could share with my students in context with what they are studying.
- Worked with a lab team, the way we generally make our students work on labs in the classroom


STEM
Integrating sciences
Inquiry
Environmental Science
Physics
Technology
Oceanography
RET II Unit Plan
Project Based Learning
Research


Big Ideas
Topics
Activities
Laws of physics under water
Pressure and Light/Depth
Animal Adaptations
Engineering adaptations
Under Pressure
Designing Floats
Creatures at Depth
Using Buoyancy
Calculating Buoyant Force
Neutral Buoyancy
Applying Archimedes' Principle
Modeling the Trieste
James Cameron's voyage: Reading/ writing activity
Technology
Types of under water craft and how scientists use them for research.
Design your own submersible blueprint
Build a working ROV
Ecology
Factors that affect D-O2
Health of an ecosystem is determined by abiotic factors like, D-O2 salinity, and temperature
Extension:
Using sensors and ROVs to collect data
Design a research project

Precursor: Get Your Students Excited About Undersea Exploration

- In order to incite curiosity I showed my class footage from http://explorationnow.org/
- Here they can see live, real time footage of scientists using ROVs to explore the deep.
- They can hear the scientists explaining what they are doing as it is happening
- They can see what the scientists see as they control the ROV camera

Its like having a marine scientist right in your own classroom!

Phase 1: Explore the Laws of Physics in the Underwater World

- Learn about different types of under sea craft and how they are used
- Research the limitations of different deep sea technology
- Connect deep sea animal adaptations to engineering needs of deep sea vessels.
- Observe that pressure increases with depth

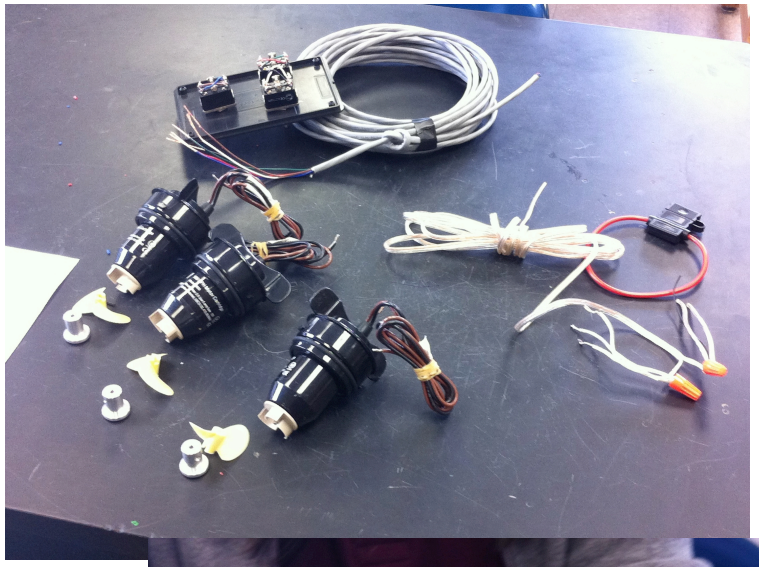
CCL 1b: Support claims with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding about the topic.

Phase 2: Undersea Exploration Technology Past and Present

- Compare technology used in exploration of the deep ocean in the past to present technology
- Determine what types of materials are best for floatation
- Model the Trieste to Explore Density and Buoyant Force

- **HS-PS2-6** Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials.

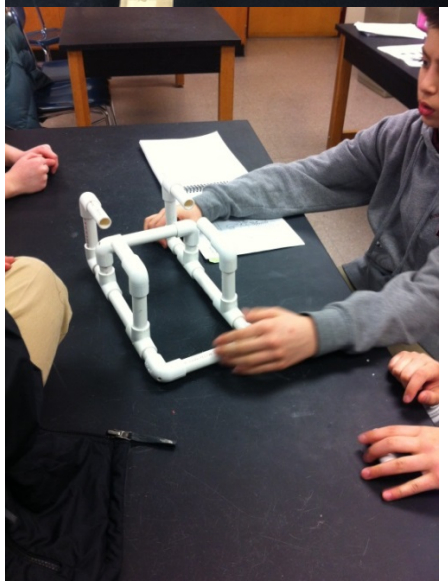
Phase 3: Build a Working Model ROV

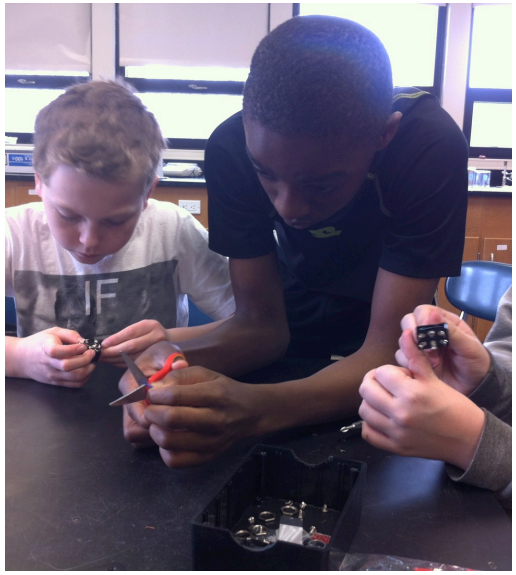


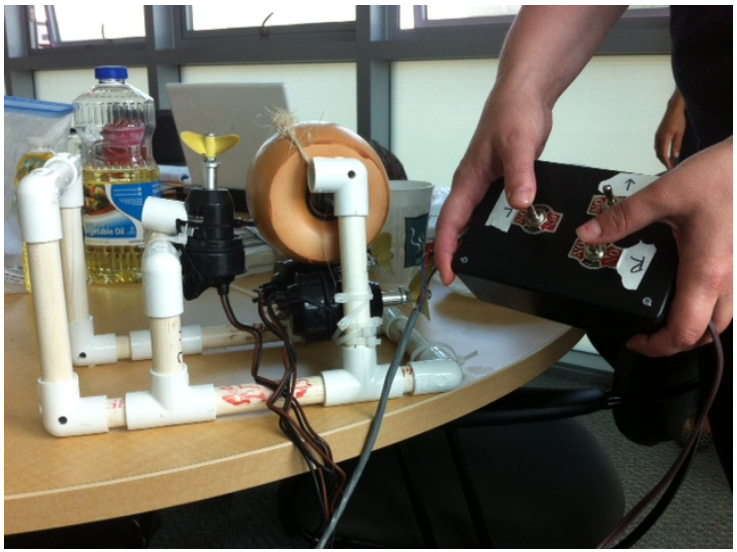
- Design Your Own Submersible Activity
- ROV Construction: MIT Seaperch

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem

ROV Construction and Testing







Extension: Use technology to collect data from aquatic or marine ecosystems

- Use the ROV constructed by students with sensors to collect data
- Form a researchable question to investigate the health of the ecosystem.

HS-LS2-6 Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

MATE ROV Competitions

- http://www.marinetech.org/rovcompetition
- http://www.flickr.com/photos/matecenter

- More than 600 teams from upper elementary, middle, high, and home schools - as well as community colleges and universities - from around the world participated in the 2013 competition season

MATERIALS RESEARCH LABORATORY
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UC Santa Barbara

Thank You!

- Materials Research Lab
- UCSB- RET
- NSF
- Dr. Frank Kinnaman
- Marilyn Garza
- Javier Cervantes
- Kyla Gupta
- Julia Pustizzi