Plankton Pioneer Project Summary

Purpose of the Project: to provide students with the opportunity to utilize the skills and knowledge gained in their physical science class to solving a real-world problem. Specifically, students were to build a submersible ROV to gather plankton for study.

Department of Education Standards Addressed:

- **Standard 1**: The Scientific Process: Scientific Investigation: Discover, invent, and investigate using the skills necessary to engage in the scientific process
- **Standard 2**: The Scientific Process: Nature of Science: Understand that science, technology, and society are interrelated
- **Standard 3**: Life and Environmental Sciences: Organisms and the Environment: Understanding the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment

Expected Outcomes: Students would be able to:

- Build a submersible remotely controlled vehicle to gather plankton
- Utilize various technologies to record the processes they followed, their observations, and the results of their work
- Test the behavior of plankton using variables such as temperature, depth, salinity, light intensity, etc.
- Write a complete, formal laboratory report
- Present their findings using PowerPoint to a panel of adults

Project Organization:

Scaffolding: In the first semester, students were introduced to the concept of force, motion, etc. To prepare them for the building the submersible they were required to build complex machines from simple machines. Because students would not be taking biology until the following year, they also had to be given lessons in animal classification, invertebrate life cycles, cycles of energy and matter (water, carbon, nitrogen, etc.), microscopy, etc.

Groupings: Students were divided into 8-person groups, with 4 teams in each group. Each team could have a maximum of two members. Each team was given a set of tasks such that the work was evenly divided between teams (see attached entry document for details). If a member of the group was unable to fulfill a particular task, other team members had the liberty of filling in, with the understanding that the points would go to the person who shouldered the extra burden. It was made clear to students that members could make up the points by doing extra for another team. The point distributions were negotiated between students, and the final scores of each team member were discussed between the members, the team coordinators, and the teacher to the point where a consensus was reached by all.

Presentation Format: Students presented to a panel of adults (Vice-Principal, Registrar, Outside Adult, Librarian). Props such as poster boards, 3-D models, equipment/tools/robots were allowed to enhance understanding by the audience. Performance was evaluated using a rubric. The rubric was designed to allow each team to be judged individually so that if one team did poorly, it did not affect the grades of other teams. If a team was evaluated by more than one judge, the scores were averaged.

Problems Encountered:

- Disagreements between team members (had to be mediated by teacher)
- Students needed to spend a lot of non-school time to complete tasks; resulted in conflicts with other interests such as band, or projects from other teachers culminating at the same time
- Because two out of five classes had mainstreamed special education students, extra clarification was required, and accommodations were imposed, which made the burden between teams less even
- Chemistry is not taught until semester two, which necessitated the project coming at the end of the school year when there is a lot of pressure on students

Plankton Pioneers Project

Requesting Body: The Phoenix Group

Scenario: Recent changes in global temperatures have begun to cause die-offs of various organisms in marine environments around the world. Coral bleaching, the disappearance of certain fish, crustaceans, mollusks and algae are occurring in areas known for being nurseries for vital food fishes. The mission of our organization, the Phoenix Group, is to conduct research in the area of renewal of lost marine habitats.

In order to properly conduct research on marine microbes (plankton, bacteria, etc.), we are looking for qualified scientists to build a submersible robot, gather samples of microbes in the affected area, and to find a technique that will allow for the reseeding of life in areas negatively affected by our fluctuating temperatures.

Qualifications: Scientists considered for participation in this mission must be able to:

- Work efficiently in a team
- Construct a submersible robot based on written instructions and schematic diagrams
- Design a plankton net that can be towed behind the submersible robot
- Set up a sterile marine environment along with appropriate lighting systems
- Test water quality using a commercially available kit
- Document all observations and data
- Write a formal laboratory report
- Present findings to a panel of professionals

Number of Team Members: 8

Project Deadline: Friday, 4/15/11
Tentative Presentation Date: the week of 4/18/11

Team Member Responsibilities:

- **Team 1 (2 people)**:
  - Marine aquarium set up, maintenance, and quality monitoring and recording (includes water testing for salinity, hardness, temperature, nitrates, nitrites, and other factors)
  - Research into, and set-up of a bioremediation filter for the tank
  - Research into chemical cycles and its application in the captive situation
  - Must be willing to come in on one Saturday (February 5, 2011) to set up sterile marine tank properly; both team members must come in to set up
  - Must be willing to come in every other day during Spring Recess (3/14/11 to 3/18/11) to continue monitoring of water quality in the tanks
- **Team 2 (2 people)**:
  - Construction of Sea Perch submersible robot and plankton net; maintenance of robot
  - Collection of plankton at designated locations; transport of plankton back to classroom, addition to sterile aquarium
  - Research into history of professional submersible ROV's and modification of Sea Perch such that it can take water samples from a determined depth, video colonies of marine microbes, etc.
  - Must be willing to seek out Mr. Silver on their own time and work with him to build the robot

- **Team 3 (2 people)**:
    - Research into past history of captive breeding of marine invertebrates, and microbes
    - Interview experts in the areas of marine organism identification
    - Research into species loss and habitat change due to global warming, el nino and la nina phenomena, both Pacific-wide as well as world-wide
    - Research into programs involved in reseeding of captive-bred organisms back into the wild
    - Create proposal to culture a specific organism for reintroduction to the wild
    - Must be willing to contact experts in the field to find out what organism would be most suitable
- **Team 4 (2 people)**:
    - Videography and Group Portfolio/Presentation preparation
    - Documentation of the construction of the robot, the collection of plankton
    - Still photographic recording (chronological) of maturation of life in the experimental tanks
    - Writing of formal Lab Report
    - Coordination of all team members for presentation of work to a panel of adults from the University of Hawaii
    - Must maintain constant communication with teacher and be coordinator between teacher and different teams

Rules Regarding Teams:

- All team members must present to the panel of adults from U.H., dressed appropriately for such an occasion
- Team members will be assessed according to their own rubrics.
    - If any team member does not fulfill his/her duty, the slack will be taken up by the remaining partner. The points that normally would have gone to the partner will be given to the member who shouldered the extra burden as GLO points.
    - If an entire team drops the ball, the other three teams will take up the slack, and the points that would normally have been earned by the irresponsible team will be shared by the members who shouldered the burden as GLO points.
    - The last day to expel a team member for failing to perform is:

Portfolio Requirements:

Completed and operational Sea Perch submersible robot fitted with a plankton net
Formal experiment proposal
Sterile marine aquarium fitted with appropriate lighting that provides rays conducive to marine growth
Journal entries of objective observations that include both narratives, tables of data, sketches, and photos
Completed experimental lab report
Historical video of project

Teacher's Note: A duplicate copy of the portfolio as well as the video must be made for the panel from the University of Hawaii for them to keep.

Project Deadline: Friday, 4/15/11
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Plankton Project Presentation Rubric

Participants: _____

Criteria	Exceeds (4)	Meets (3)	Approaches (2)	Does Not Meet (0-1)	
Content					
Team #1					
Purpose of the Plankton Project	Purpose of the project is stated clearly and completely; strong connections made to science standards	Purpose of the project is stated clearly and completely, but connections to science standards are made, but not detailed	The purpose is stated, but may be confused on one or two parts; statement incomplete; no connection made to science standards	The purpose is stated, but is not clear, or is incomplete; no mention made of connection to science standards	
Marine Tank Design	Clear and complete explanation of how they built the tank and why; exceptional insight shown	Clear and complete explanation of how they built the tank and why	Explanation is given of how they built the tank but may be confused as to why; explanation is not complete	Explanation is given of how they built the tank but the rationale behind their choices is not stated	
Bioremediation	Exceptionally clear and complete explanation of what bioremediation is and what chemical cycles and processes are involved in its function; members are able to answer any and all questions from audience	Clear and complete explanation of what bioremediation is and what chemical cycles and processes are involved in its function; members are able to answer most questions from audience	Explanation given of what bioremediation is, but it is unclear or incomplete what chemical cycles and processes are involved in its function; members are unable to answer most questions from audience	Members are unable to explain what bioremediation is or what chemical cycles and processes are involved in its function; explanations are poor and incomplete	
Application of Bioremediation to the Marine Environment	Clear and complete explanation of how they plan to adapt the concept of bioremedia-tion to a marine tank; explanation is backed by research; schematic diagram or model shown	Clear and complete explanation of how they plan to adapt the concept of bioremedia-tion to a marine tank; explanation is backed by research, but no schematic diagram or model shown	Explanation of how they plan to adapt the concept of bioremediation to a marine tank given, but explanation is not backed by research, the rationale is not clear, and no model or schematic diagram shown	Members are unable to clearly and completely explain how they plan to adapt the concept of bioremediation to a marine tank; explana-tion is not backed by research; no model or schematic diagram shown	
Problems and Lessons Learned	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows exceptional critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems, but their explanation shows poor critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	
Team #2					
History of ROV Development	Exceptionally clear and concise timeline of most important ROV events shown in efficient manner; strong connection made to Sea Perch used in project	Clear and concise timeline of most important ROV events shown in efficient manner; connection made to Sea Perch used in project	Timeline of most important ROV events shown , but no clear connection made to Sea Perch used in project	Timeline of ROV development shown, but is incomplete; no connection made to Sea Perch used in project	
Buoyancy	Clear and complete description of what buoyancy is and how Sea Perch buoyancy was adjusted; logical	Clear and complete description of what buoyancy is and how Sea Perch buoyancy was adjusted; rationale	Unclear or incomplete description of what buoyancy is and how Sea Perch buoyancy was adjusted; no	Poor description of what buoyancy is and how Sea Perch buoyancy was adjusted; no rationale given for	

	rationale given for need for both neutral and slightly positive buoyancy	given for need for neutral or slightly positive buoyancy, but not both	rationale given for need for neutral or slightly positive buoyancy	need for neutral or slightly positive buoyancy	
Plankton Collection	Exceptional insight regarding what plankton are, where they are found, and how they are most easily collected	Good explanation regarding what plankton are, where they are found, and how they are most easily collected	Poor explanation regarding what plankton are, where they are found, and how they are most easily collected	Little or no explanation regarding what plankton are, where they are found, and how they are most easily collected	
Design of Plankton Net on Sea Perch	Clear and complete explanation of how they plan to design the plankton net for use on a Sea Perch; explanation is backed by research; schematic diagram or model shown	Clear and complete explanation of how they plan to design the plankton net for use on a Sea Perch; explanation is backed by research; no schematic diagram or model shown	Explanation given of how they plan to design the plankton net for use on a Sea Perch, but explanation is not backed by research, the rationale is not clear, and no model or schematic diagram shown	Members are unable to clearly and completely explain how plan to design the plankton net for use on a Sea Perch explanation is not backed by research; no model or schematic diagram shown	
Problems and Lessons Learned	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows exceptional critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems, but their explanation shows poor critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	
Team #3					
Effects of Global Warming, El Nino and La Nina on Plankton/Invertebrate Populations	Exceptionally clear and concise connections made between the Global Warming, El Nino, and La Nina on plankton and invertebrate populations; examples given based on research	Clear and concise connections made between the Global Warming, El Nino, and La Nina on plankton and invertebrate populations; examples given based on research	Connections between the Global Warming, El Nino, and La Nina on plankton and invertebrate populations given, but are incomplete; examples based on research not cited	Global Warming, El Nino, and La Nina are described, but no connections made to plankton or invertebrate populations; examples based on research not cited	
Captive Breeding Programs	Excellent examples of captive breeding of marine invertebrates given; rationale given for breeding of invertebrates	Good examples of captive breeding given, including terrestrial organisms; rationale for captive breeding given	Examples of captive breeding given, but descriptions are incomplete and rationale for captive breeding unclear	Examples of captive breeding given, but descriptions are incomplete and rationale for captive breeding missing	
Proposal for Captive Breeding in Classroom	Clear and logical reasons given for choice of marine invertebrate; research cited to back up choice; complete procedure and materials list provided	Good reasons given for choice of marine invertebrate; complete procedure and materials list provided	At least one reason is given for choice of marine invertebrate; procedure and materials list provided, but inconsistencies or lack of completeness evident	No clear or logical reason given for choice of marine invertebrate; procedure and/or materials list missing	
Problems and Lessons Learned	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows exceptional critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems, but their explanation shows poor critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	
Team #4					
Experimental Format	Experiment is exceptionally well designed; purpose is	Experiment is well designed; purpose is clear; procedure is	Experiment is poorly designed; purpose is not clear; procedure is	Experiment is poorly designed; purpose is not clear, complete or	

	clear, procedure is complete and logically structured; all parts of the lab report present; variable tested for is clear	complete and logically structured; all parts of the lab report present; variable tested for is clear	incomplete or lacking in structure; one or two parts of the lab report missing; variable tested for not clear	logically structured; three or more parts of the lab report missing; variable tested for not given	
Experimental Data and Observations	Exceptional presentation of data using tables and graphs; data and observations complete	Good presentation of data using tables and graphs; data and observations complete	Poor presentation of data; observations missing; data tables but not graphs given; data or observations incomplete	Data and or observations not made or poorly done	
Analysis and Conclusion	Exceptional insight on plankton behavior based on data and observations made; strong use of evidence to draw conclusion	Good insight on plankton behavior based on data and observations made; use of evidence to draw conclusion	Statements regarding plankton behavior not clearly connected to data or observations made; little use of evidence to draw conclusion	Statements regarding plankton behavior not cconnected to data or observations made; no connection between evidence and conclusion	
Problems and Lessons Learned	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows exceptional critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems, but their explanation shows poor critical thinking and problem-solving skills	Members describe the problems they encountered and explain how they overcame those problems; their explanation shows critical thinking and problem-solving skills	
Presentation Style					
Preparedness (x 2)	Students are completely prepared and have obviously rehearsed; members glance at, but don't read off the screen	Student seems pretty prepared, but might have needed a couple more rehearsals; read off the board 50% of the time	Student is somewhat prepared, but it is clear that rehearsal was lacking; read off the board more the 50% of the time	Student does not seem at all prepared to present.	
Enthusiasm (x 0.5)	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language occasionally generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat forced.	Very little use of facial expressions or body language. Did not generate much interest in topic being presented.	
Speak Clearly (x 0.5)	Members speak clearly and distinctly all (100%) of the time, and mispronounce no words.	Members speak clearly and distinctly all (95%-100%) the time, but mispronounce one or two words.	Members speak clearly and distinctly most (85%-94%) of the time. Mispronounces more than two words.	Often mumbles or cannot be understood OR mispronounces more than five words.	
Posture and Eye Contact (x 0.5)	Stands up straight, looks relaxed and confident. Establishes eye contact with everyone in the room during the presentation.	Stands up straight and establishes eye contact with everyone in the room during the presentation with slight tension.	Sometimes stands up straight and establishes eye contact.	Slouches and/ or does not look at people during the presentation.	
Volume (x 0.5)	Volume is loud enough to be heard by all audience members throughout the presentation.	Volume is loud enough to be heard by all audience members at least 90% of the time.	Volume is loud enough to be heard by all audience members at least 80% of the time.	Volume often too soft to be heard by all audience members.	