

Exploring the Marine World

Authors:

Mark Miller, Sherryl Peters, and Paul Quiggle

Context of the Module:

This module is part of a larger group of activities designed to promote student understanding of the marine environment. It follows a module designed to familiarize the student with marine life and precedes a module designed to help the student explore the marine environment in-situ.

Pre-requisites:

Section I:

Required Courses: Successful completion of English I, Physical Science, Algebra I.

Section II:

Required Background: Successful completion of marine life module.

Mission Statement:

The short-term mission of MAROVIAH (*Make an ROV in a hurry*) is to demonstrate the ability of robotics and optics to operate within the confines of a remotely operated vehicle. We intend to photographically document the participants of the MATE (*Marine Advanced Technology Education*) "Teachers and Technology: ROVing the Oceans" 2000 international competition. Upon successful completion of this mission we will embark on our long-term goal of incorporating real time video into an ROV. Additionally, we will use the robotic technology applications to design an articulated appendage capable of retrieving biological and geological specimens as well as historical artifacts.

Student Learning Outcomes:

1. Design and construct a working ROV using set material limitations. (MT-A2, A6)
2. Calibrate and align equipment for designed task. (ROV-C5)
3. Operate LARS (Launch and Recovery Systems). (ROV-A6, MT-D2)
4. Use selected tools (power and hand) appropriately. (ROV-A1, 2, 5, MT-A2)
5. Coordinate and integrate with class- and teammates. (ROV-D2, MT-E1, 2)
6. Utilize mathematical techniques/formulas/processes and records results (SCANS)
7. Probe to gain knowledge/information, qualify/analyze information and interpret and summarize information. (SCANS)
8. Apply rules/principles to process/procedure, extract information/data and use logic to draw conclusions. (SCANS)
9. Develop creative solutions, apply creative solutions to new situations. (SCANS)
10. Present complex ideas/information, analyze group/individual responses, pose critical questions. (SCANS)
11. Explore how scientific knowledge fuels technological advances and how technology creates new scientific knowledge. (AAAS Project 2061, p. 190, Standard 8B)

12. Participate in an engineering process to analyze and gather relevant information, define problems, generate and evaluate creative ideas into tangible solutions, and assess and improve their solutions. (AAAS Project 2061, p. 48, Standard 3B)
13. Write a technical report on their ROV engineering process. (AAAS Project 2061, p. 295, Standard 12D)
14. Use an ROV as an instrument to extend human observational and manipulation skills. (AAAS Project 2061, p. 292, Standard 12C)
15. Use the ROV as a system to demonstrate detailed attention to inputs and outputs within a system. (AAAS Project 2061, p. 262, Standard 11A)

Sources

Benchmarks for Science Literacy, Project 2061, American Academy for the Advancement of Science, Washington, D.C., 1994.

Build Your Own Underwater Robot and Other Wet Projects, Harry Bohm & Vickie Jensen, Westcoast Words, Vancouver, B.C. Canada, 1997.

Knowledge and Skill Guidelines for Marine Technicians, MATE Center, Monterey Peninsula College, Monterey, CA., 2000.

Knowledge and Skill Guidelines for ROV Operators, MATE Center, Monterey Peninsula College, Monterey, CA., 2000.

ROV Fundamentals, William J. Kirkwood, Monterey Bay Aquarium Research Institute.

Target Audience

This module is designed for high school grades 10-12. It can be adjusted for higher-grade levels by intensifying the design and mission outcomes. It can be modified for lower grade levels by lessening the mission outcomes and providing pre-wired/pre-fabricated models.

Warnings

1. Standard NSF lab safety precautions are applicable to this module.
2. Instructions for safely using drills and drill bits must be presented.
3. Soldering equipment, drills & drill bits.

Assessments

See end of this document for assessment rubrics.

Warnings

1. Standard NSF lab safety precautions are applicable to this module.
2. Instructions for safely using soldering equipment and procedures must be presented.
3. Instructions for safely using drills and drill bits must be presented.

Time Required

This module should be introduced, completed and assessed in ten (10) instruction hours.

Required Materials

Per group of 3 students:

- 4 6 volt batteries
- 1 10' _" PVC pipe
- 10 T _" PVC pipe connectors
- 10 L _" PVC pipe connectors
- 1 100' roll electrician's tape
- 1 50' stranded speaker wire
- 1 roll clear flux solder wire
- 1 ruler
- 4 2-1/2" hobby propellers
- 4 9-volt motors
- 2 pair alligator clips
- 4 2-way toggle switches
- 1 40' x 22 gauge enamel-coated magnet wire

Per class of 30 students:

- 2 drills with various-sized bits
- 2 soldering irons with tips
- 2 wire cutters/strippers
- 2 mini-vise
- 2 long-nose (needle-nose) pliers
- 2 PVC pipe cutters
- 5 pairs scissors
- 2 wood blocks for cutting/drilling
- 2 utility knives
- 3 boxes 20-penny nails
- 10 10' PVC pipe foam insulation wraps

Procedures

Given the materials found on the tables at the side of the room (see attached equipment list) you are to build an ROV that will successfully accomplish a mission of your choice. After completing the construction of your ROV you will set up and carry out your mission in the school's swimming pool. To complete this assignment you must accomplish the following tasks:

1. Define your mission.
2. Decide how your ROV will accomplish your mission including how you will power, propel, navigate, and control your ROV; what you will use for structure and to adjust buoyancy
3. Design your ROV and draw initial construction plans.
4. Construct and test your ROV.
5. Draw complete plans, to scale, of your ROV including wiring diagrams.
6. Document your engineering efforts in a written report that includes a description of their mission, how you will accomplish that mission, and why you made your design decisions.

7. Launch your ROV, carry out your mission, and recover your ROV.
8. Write an evaluation of the success of your mission and explain what changes you would make to improve your ROV if you had the chance to modify it.

Discussion Questions

Before:

1. List and explain two methods scientists use to discover and document marine life.
2. Explain why a ROV is a more desirable marine data collector than a “live scientist”.

During:

1. Why is it desirable for a resting ROV to float?
2. What type manipulators/tools should be attached to the ROV? List their mission functions.
3. What differences do propeller lengths make to the ROV's thrust?

After:

1. How can the mission of the ROV be enhanced?
2. In what other environments can ROV's function?
3. How can this ROV be modified to function in one or more environments?

SCANS:

1. Which skills did you use to complete this module that an employer would find desirable?
2. Why is it necessary for an ROV operator to also be familiar with ROV design specifications?
3. How independently did you and your teammates work in order to complete this module?

Extension Lessons

1. This module may be extended to utilize additional ROV tools by altering the mission.
2. Students may expand their personal knowledge by researching actual ROV missions and applying them to enhance the capabilities of the ROV.
3. An extension class project might involve presentation of the construction techniques and mission to other classes or the general public.

Assessments

Examples of assessment rubrics for three of the above outcomes:

Assessment Rubric for outcome #3: Operate launch and recovery system.

Task: Students are to launch their ROV, accomplish their proposed mission, and recover the ROV.

	A	B	C	F
Effective Launch	ROV is quickly easily launched. No parts are lost or damaged, tether is not tangled in the ROV.	Launch is successful but slowed because of entanglement with the tether.	Launch is successful but some minor damage is done to the ROV.	Launch fails; ROV is damaged to the point it will not function properly, or is hopelessly entangled in the tether.
Effective Recovery	ROV is quickly easily recovered. No parts are lost or damaged, tether is not tangled in the ROV and is not pulled on as a part of the recovery.	Recovery is successful but slowed because of entanglement with the tether and is not pulled on as a part of the recovery.	Recovery requires pulling on the tether for a short distance to recover the ROV.	ROV is lost or must be dragged a large distance by the tether to the surface.

Assessment rubric for outcome #5: Coordinate and integrate with class- and teammates.

Use the following rubric to assess your performance as a group member as well as the performance of each of your group members.

	A	B	C	F
Effective group participation	Completed her/his share of the work and provided leadership in some area of the task, helped others learn.	Completed her/his share of the work and provided some leadership in some area of the task.	Completed his/her share of the work but nothing else.	Did not complete his/her share of the work.

Assessment rubric for outcome #13: Write a technical report on the ROV engineering process.

Task: Students are to document their engineering efforts in a written report that includes a description of their mission, how they will accomplish that mission, and why they made their design decisions.

	A	B	C	F
Effective Paragraphs	Paragraphs always communicate ideas clearly are well organized with a clear <i>topic sentence</i> that is supported by well developed with <i>concrete details</i> which are explained with <i>commentaries</i> .	Paragraphs generally communicate ideas clearly and are well organized. <i>Topic sentences</i> are supported by <i>concrete details</i> and explained with <i>commentaries</i> .	Paragraphs generally communicate the ideas clearly. <i>Topic sentences</i> are present and supported.	Ideas are not clearly communicated.
Effective Sentences	Sentences communicate ideas clearly, are well organized and almost always grammatically correct.	Ideas are communicated clearly. Grammatical errors do not interfere with understanding.	Sentences communicate ideas. Grammatical errors do not interfere with understanding.	Sentences contain frequent errors that make understanding difficult.
Effective Vocabulary	Explanations use the science vocabulary correctly and consistently. Spelling is correct.	Scientific vocabulary is frequently used with very few errors. Spelling is generally correct.	Scientific vocabulary is often used with only occasional errors. Spelling errors do not interfere with understanding.	Errors are frequent and interfere with understanding.
Overall Effect	Your writing clearly shows that you understand the question posed and have	Your writing shows that you understand the question posed and have answered the question	Your writing shows a basic understanding of the question. The science behind your	Writing shows very little or no understanding of the question or the science behind your

	answered it clearly and completely. It is easy to read and understand.	accurately but requires more detail.	answer is accurate. You have not shown a complete understanding.	answer.
--	------------------------------------------------------------------------	--------------------------------------	------------------------------------------------------------------	---------

