

Robo-Nemo

“Educating youth about ocean research!”



sponsored by the
National Science Foundation

created by
Monique Chyba and Ryan N. Smith
University of Hawaii at Manoa
Department of Mathematics

in conjunction with
Autonomous Systems Laboratory and
the Ocean & Resources Engineering Department

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Introduction

The purpose of this project is to introduce young students to the science of underwater technology. Teaching young students may encourage their pursuit of careers in science, research, and technology. Through this program students experience the unique opportunity of being in contact with research scientists in an academic setting.

Project Description

Robo-Nemo is an educational project developed by the Department of Mathematics at the University of Hawaii. The project was created by Monique Chyba, Assistant Professor in the Mathematics Department, and Ryan N. Smith, a graduate student in the Ocean & Resources Engineering Department. It is designed to teach children the science of underwater vehicles and hydrodynamic principles. This project is designed to be hands-on and interactive, including university faculty, graduate students, research staff, teachers, and students alike. Our young matriculators interact with real underwater robots as part of a guided tour of an active scientific research project. The pilot project was successfully tested on thirty six Montessori Community School students, ages three to six years old. Our activities are altered to correspond to the age of the students. For example, older students design underwater vehicles themselves instead of simply assembling them. Older students also receive more advanced instruction on underwater technology and the inner workings of scientific research projects.

Our program is divided into three parts. Dive One consists of a classroom visit to introduce the basics and motivate the material we will be discussing. During Dive Two, the classroom students construct their own submarine. Dive Three is a field trip to the University of Hawaii (UH) swimming pool, where the children meet the Omni-Directional Intelligent Navigator (ODIN) face to face. ODIN is an Autonomous Underwater Vehicle (AUV) built and maintained by the Autonomous Systems Laboratory (ASL) at UH.

Through our program, young students learn the answers to some basic questions, such as:

- What is hydrodynamics?
- What is buoyancy?
- What is density?
- What is viscosity?
- What does it take to go underwater?
- What kind of people go underwater?
- What kind of animals go underwater?
- How long can things be underwater?
- What is a professor?
- What is the UH campus like?
- How do you build a submarine?
- What is the difference between positively / neutrally / negatively buoyant?
- What does an underwater vehicle look like?

Project Details

Dive One

Students gather for a brief discussion about water and the ocean. We discuss movement in the water versus movement on land and in the air. We compare some of the creatures inhabiting these different environments. We then present a movie containing clips from Finding Nemo (2001), 20,000 Leagues Under the Sea (1954), Diving Poipu, ODIN In Action. We stop the movie at certain points to discuss the ocean principles presented in the film.



Image 1: Students ask questions about hydrodynamics during the movie.

After the movie, we divide the class into three stations: 1) Underwater ABC's, 2) Snack, 3) Density, Buoyancy, and Viscosity. At station one, students come up with a water related word for each letter of the alphabet. At station two, students construct an underwater creature (fish, turtle, etc.) using the healthy snacks we provide. For example, they might make a turtle from a rice cake, a few strawberries, and two halves of a cracker. At station three, we discuss the poster displayed in Image 3.



Image 2: Professor Chyba discusses buoyancy.

We set up three cups containing air, water and honey, then discuss their differences in viscosity and density. We also discuss buoyancy; such as why a person can float in water, but not in air. We introduce many different types of underwater vehicles that are used today by scientists.

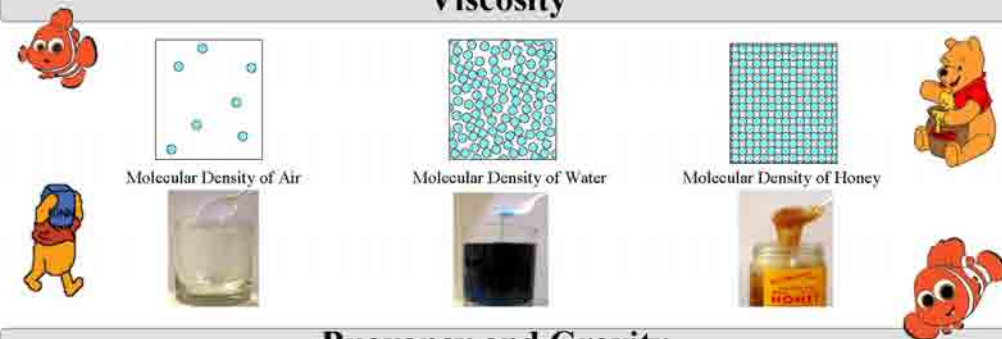
NATIONAL SCIENCE FOUNDATION

HYDRODYNAMICS

Motion



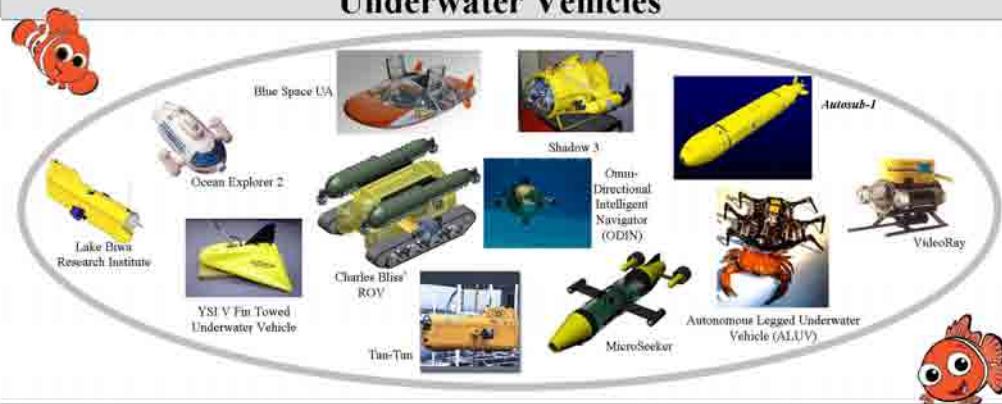
Viscosity



Buoyancy and Gravity



Underwater Vehicles



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Department of Mathematics, Autonomous Systems Laboratory and
Ocean and Resources Engineering



Image 3: Hydrodynamics poster.

Dive Two

During Dive Two, students assemble the submersible shown in Images 4, 5, and 6. Students build their vehicle and then get to test it in a small pool (Image 6).



Image 4: The submarine kit.



Image 5: Students assemble their sub-marines.

At first the submarine just floats. Since this is not what a sub is supposed to do, we guide the students to discover that we need weight to make it submerge. Each student gets a premeasured weight bag to place into their sub. Many colors are offered, so some customization is possible. Image 5 shows the submarine kit that each student assembles. After adding more weight, we test the subs again and find they are neutrally buoyant. Students keep their subs for future exploration on their own.



Image 6: Students test their submarines.

Dive Three

This day is a field trip to the University of Hawaii at Manoa. Students first arrive at the UH pool to see underwater vehicles in action. ODIN is the main focus for this event. ASL operates ODIN and explains the controls and how the robot is constructed.



Image 7: Students arrive at UH pool.
Photo by Joel Pfeiffer.



Image 8: Students meet ODIN.
Photo by Joel Pfeiffer.

Students can also view the action through a porthole in the side of the pool, about three feet underwater.



Image 9: Students view underwater vehicles through the porthole.
Photo by Joel Pfeiffer.

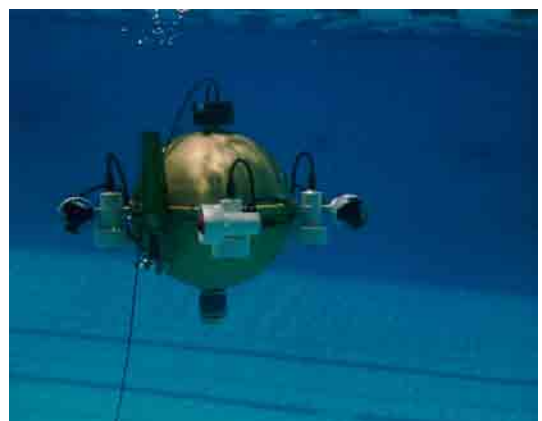


Image 10: ODIN underwater.
Photo courtesy of ASL.

We also deploy an ROV called the VideoRay, shown in Image 11. We drive from shore by a joystick, with an onboard camera projected on a screen at our onshore control center. This allows students to see the view from an operating ROV.



Image 11: The VideoRay ROV.



Image 12: The Ocean Explorer 2.

Students also get a chance to test their piloting skills by controlling one of the five Ocean Explorer 2 submarines (Image 12).

Students then receive a small snack and a map of the UH campus. After leaving the pool, we trek from lower campus up to Keller Hall and the Mathematics Department. Once in Keller Hall, students meet with professors and graduate students and discuss what people do in colleges and universities. Depending on their age, students then color or draw underwater scenes.



Image 13: Students meet with UH professors.



Image 14: UH Math grad student, Micah Chrisman, colors with students.

At the end of the day, students each receive a souvenir picture from the event.

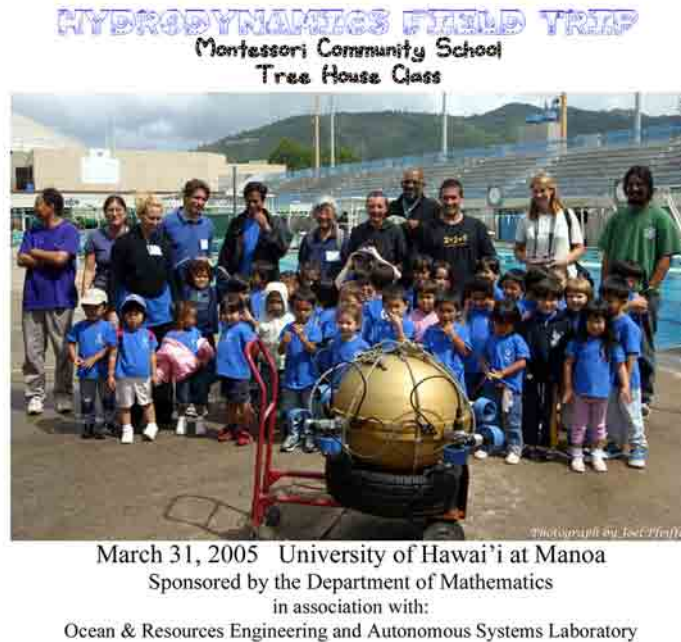


Image 15: Souvenir picture given to each student.

Pilot Project

We taught this program, as outlined, during the week of March 27, 2005 with the Montessori Community School Tree House Class. These students ranged in age from three to six years old. They had fun while learning about ocean science and their response to the project was very enthusiastic. We received hand drawn pictures of either ODIN, underwater activities, or submarines from each of the thirty six students. Along with this were many thank you notes and warm wishes of aloha for the fun filled days that we spent with them.

Acknowledgments

During the pilot project with the Montessori Community School, there were many people who assisted with their time and donations. We would like to thank everyone who took part in the pilot, especially:

- The National Science Foundation
- The University of Hawaii Mathematics Department
- The Ocean & Resource Engineering Department
- Side Zhao and ASL
- Graduate students from the Mathematics Department and Ocean & Resources Engineering
- The UH pool staff
- Pfeiffer Productions
- The Hobbietat
- Steven and the crew at Kinko's on Beretania

Robo-Nemo Photo Library

Submarine Assembly



Aquatic Vehicle Experiments





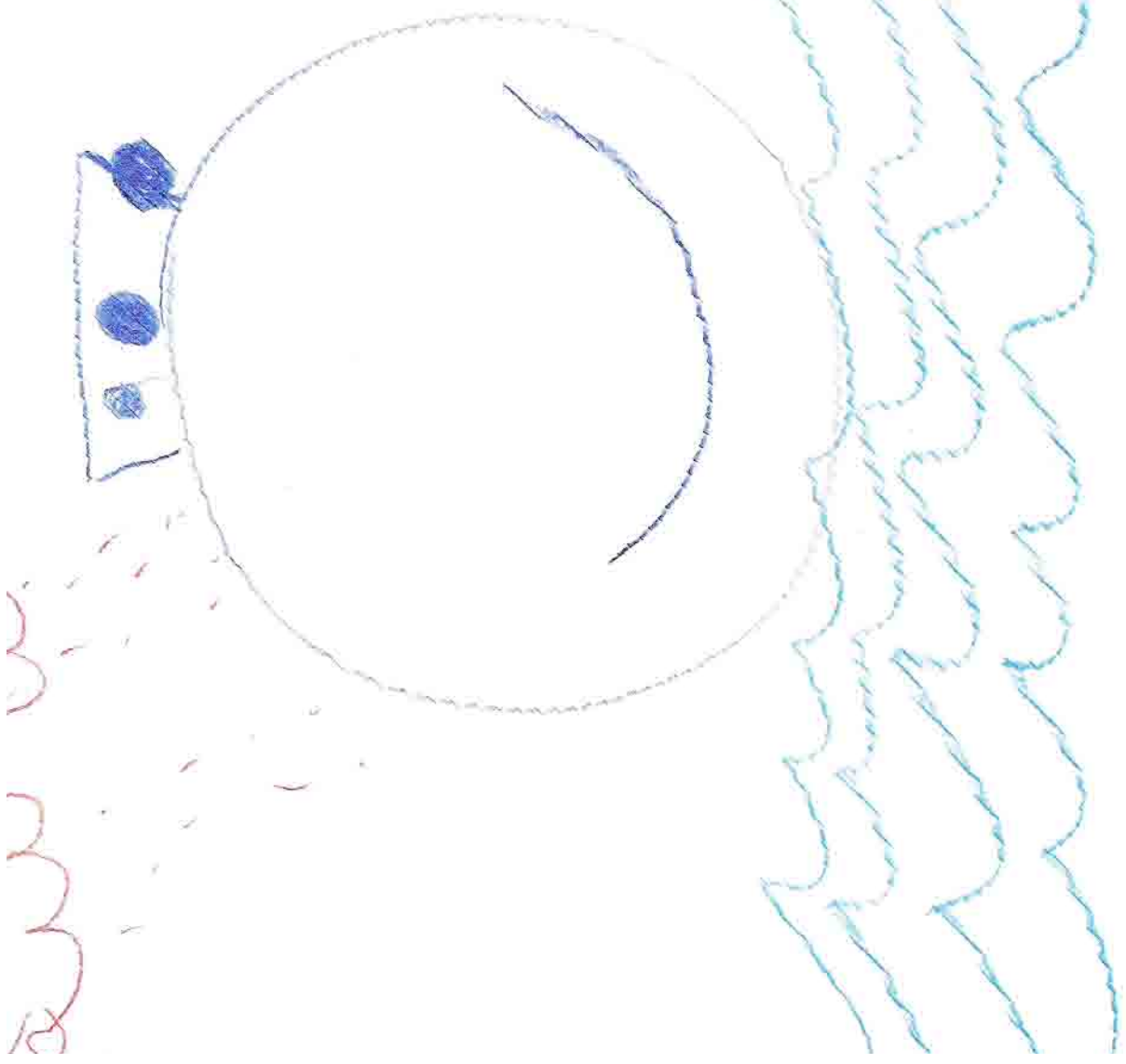
April 19, 2005

Dear Professor Chyba, Ryan and Staff,

Thank you so much for making us a part of your study. We had fun with your visits and had so much fun creating our own submarine models. Our visit to your campus was another learning experience for us. We were thrilled to have the chance to look at and experience the underwater devices. ODIN was the most popular of them all. Thank you for giving us this wonderful learning opportunity.

Sincerely Yours,

The Tree House Teachers and Students



Thank you!!

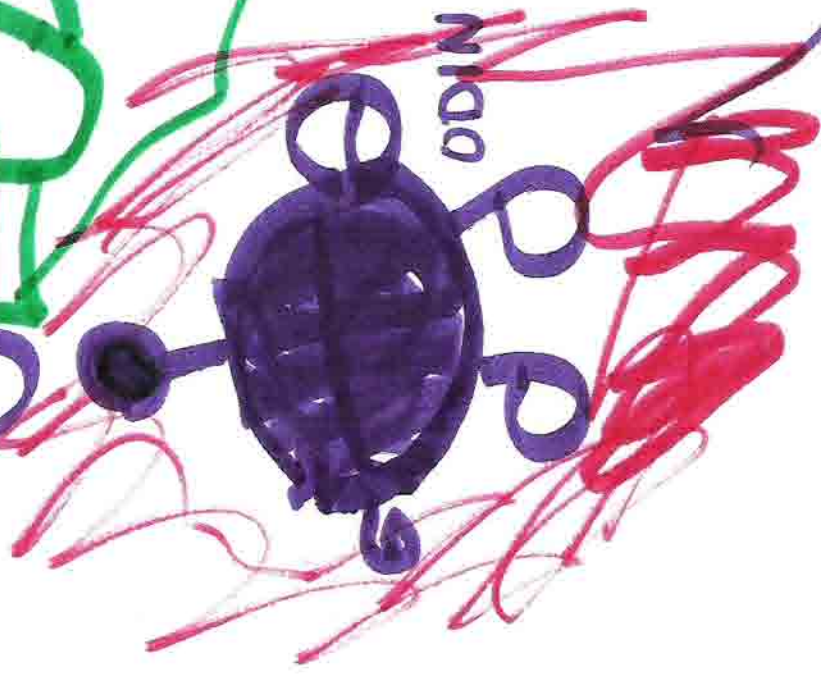
THAT'S MY

RYOBU.



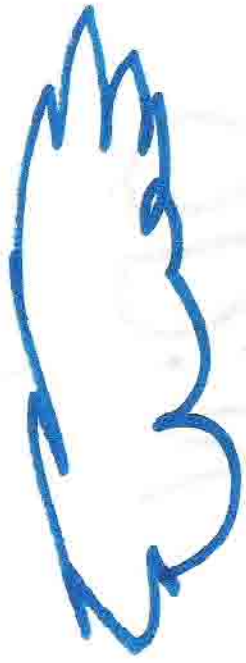
-This is Ryan

MARIKO



ODIN





Heath Her



The
Swimming
pool

This is
ODIN