# Diving into real world challenges

Bridging the disconnect between the classroom and the real world brings learning alive, as this marine robotics program demonstrates.

More than 8,500 oil-bearing ships lie on the world's ocean floor. Some of these ships, including the USS Arizona, leak their hazardous cargo into our oceans every day. Does this sound like a "real world" problem? The new California Common Core Standards refer to "real world" learning 49 times in the mathematics standards alone. How do we as educators engage our students in real world learning using their academic knowledge and technical skills?

Long Beach City College and Long Beach Unified School District, as well as many other districts, have discovered that the world of robotics can help students use technical skills to solve simulated problems found in the real world, while understanding the relevance of challenging academics. The Marine Advanced Technology Education (MATE) Remotely Operated Vehicle (ROV) student competition is a program that does just that.

## The MATE ROV student competition

The Marine Advanced Technology Education Center is one of many valuable industry/education resources that creates new curricula that include student competitions based on real world problems. Employers help design these curricula that build upon the requisite skills for marine-related occupations, such as ship-board (research) technician, remotely operated vehicle technician, hydrographic survey technician and oil spill response technician. Many of these occupations are technically advanced, high paying jobs that require specialized academic knowledge and technical skills.

The international student underwater robotics competition is coordinated by the MATE Center, which includes a network of 21 regional ROV contests that take place across the United States and internationally. Participating student teams are from upper elementary, middle schools, high schools, home schools, community colleges, universities and community organizations.

In addition to building technical knowledge and skills, the event helps students develop the ability to problem-solve, think critically, and work as part of a team. By connecting students with employers and professionals, the competitions also expose students to ocean-related career opportunities and to the pathways to those careers.

## Mission possible! The academic and technical challenge

Long Beach City College Robotics instructor Scott Fraser is the driving force behind the student competition, with support from Long Beach City College, Monterey Peninsula College and the National Science Foundation.

The student teams act as entrepreneurial companies that respond to a request for proposal from a "client," which is the MATE Center. They are challenged to design and develop an underwater robot, using half-inch PVC pipe, a propulsion system using 12 volt waterproofed motors, adapted underwater 12 volt cameras and lots of ingenuity in order for the robot to accomplish the various tasks

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developed by the MATE center – underwater and remotely!

The competition begins with a mission scenario and detailed tasks. The mission scenario was based on the historical records of the SS Gardner, which sank in 1942, carrying a cargo of roughly 5 million gallons of bunker (fuel) oil. The ship, which was hit and sunk by a German U-boat, now lies on the ocean floor approximately 30 nautical miles off of the east coast of Florida.

The students' mission was to complete an assessment of the vessel, including its location and orientation on the sea floor; the debris field that surrounds it; the state of its hull and contents on board; and any other information necessary to develop and carry out a plan to remove any remaining oil.

Students were challenged to design sensors that would simulate an ultrasonic thickness gauge and a neutron backscatter device. The MateRover task specifications state that "The ultrasonic thickness gauge works by measuring the amount of time it takes for sound waves to travel through the hull and back. It then calculates the thickness based on the speed of the sound through the hull. ... The thickness of the hull is used to calibrate the neutron backscatter device. Once calibrated, (the students) placed the neutron backscatter device on the hull to test for the presence of oil. "

### Teacher preparation

At the beginning of the MATE ROV challenge, Long Beach USD teachers received extensive training at Long Beach City College, with the assistance of Scott Fraser and many volunteers from his robotics program, along with community and business volunteers. The training included basic design processes, an overview of Direct Current (DC) theory, development of a prototype robot, and practice with neutral buoyancy with the prototype.

Due to the engaging nature of the project, teachers were highly motivated as they prepared to give their students an academically rigorous and "real world" problem-solving experience. Parents were enthralled as they observed their children participating in the "hands-on and mind-on" academic and technical challenges.

### From conceptual ideas to design and prototyping

At the school site, teacher coordinators and students met to begin the conceptual design process, beginning with brainstorming, and then transitioning to sketching and building various prototype ROVs. The design process includes planning and working with the guidelines (and constraints) of the technical specifications provided. For example, the 12V motors/propellers were required to be contained within the footprint of the vehicle, and if the propellers were outside the footprint, they were required to be housed within a sleeved shield/housing.

Additional factors to consider were the weight distribution and balance that the apparatus needed for the actual tasks, including the 12V cameras. Included in the process were calculations of the amount of foam needed to counter the weight of the vehicle so that neutral buoyancy could be achieved.

Once a prototype ROV was developed, the vehicle was taken to a pool or body of water, where the propulsion system and buoyancy were tested. Also critical to the success of the project was the balance of the vehicle underwater when attempting to achieve the assigned tasks. As balance and neutral buoyancy were achieved, the students could then begin to work, with both accuracy and time efficiency being critical to the success of the challenge.

Volunteer judges verified the completion of tasks and assigned points, based on evidence of completion of tasks. An engineering



**Beach High School students Christian Mojica (left) and Edward Rhodes (second from right) show their ROV to judges at a Long Beach competition.**

review was conducted by separate judges, who questioned the students on their actual participation, from concept to design, prototyping, fabrication, testing and their results.

### Outcomes: An integrated approach to real world learning

With the implementation of the new California Common Core State Standards, we must engage students in real world problem solving, thus creating meaning to their learning. Allowing students to grapple with real world problems brings relevance to their academic studies and connections to future careers.

Problem solving and critical thinking skills are essential for our students to succeed in the 21st century workplace. Bridging the disconnect between the classroom and the real world brings classroom learning alive. When students integrate their learning in history, science, mathematics, English language arts, the arts and career technical education to tackle real problems, aren't they learning how to function in the "real world," after all? ■

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