



MONTEREY BAY AQUARIUM®

Underwater Robotics: Ocean Invaders

The Monterey Bay Aquarium/Marine Advanced Technology Education (MATE) Center's

5th Annual Remotely Operated Vehicle Contest

Monterey Peninsula College

April 16, 2005

Contest Specifications – Scout Class

Visit the contest web site at http://www.mpcfacylty.net/mbamate_rovcontest/ for more information and updates!

Note: This year there will be TWO competition classes – Scout and Ranger. The **Scout** class is designed for teams that are new to ROV design and building or prefer to design and build a KISS (Keep It Simple Silly!) ROV; Scout vehicles operate at a maximum of 12 volts, 7 amps. The **Ranger** class is appropriate for teams that are ready for the “next step” and the challenge of adding a camera to their vehicle; Ranger vehicles operate at a maximum of 13 volts, 25 amps. The top two winners of the Ranger class will move on to compete in the national ROV competition organized by the MATE Center and the Marine Technology Society's ROV Committee (see the **Contest Specifications – Ranger Class** document for more information).

The Scout class will consist of two pool events, a Design and Innovation category, and a Team Display. The Ranger class will consist of three “underwater Olympic” events (which will require a camera), an Engineering Evaluation (similar to the Design and Innovation category), and a Poster Display.

Contest Eligibility:

- The ROV contest is open to students in grades 6 through 12.
- Registration packets must be submitted by **February 18th, 2005**. Only completed registration packets will confirm a space in the contest.
- The **Scout class** is limited to the first 50 *complete* registration packets, maximum 3 entries per school/organization. The **Ranger class** is limited to the first 20 entries; schools/organizations interested in entering two teams will be considered.
- All entrants must be affiliated with a school, home schooling network, or other educational organization.
- Complete registration packets must include:
 - Registration form (1 per team)
 - Event waivers (1 for *each* team member)

SCOUT CLASS – Competition Categories (middle & high school divisions):

Teams will be entered into the following contests:

1. **Design and Innovation.** Engineers and ROV pilots and technicians from the Monterey Bay Aquarium Research Institute (MBARI) will be on hand to evaluate teams on the creativity of their design and innovative use of materials. (See the design score sheet posted on the contest web site for the judging criteria.)

Want to learn more about MBARI? Visit its web site at <http://www.mbari.org>.

2. **Ocean Invaders.** Teams will pilot their ROVs to the bottom of the MPC swimming pool (maximum depth 5 feet) to retrieve several species of fish that have invaded the bay. The fish are slightly negatively buoyant; a small weight tied to the end of fishing line weights them to the bottom.

This is a timed event; each team has a maximum time of 10 minutes to retrieve as many fish as possible. Certain fish will be redeemable for prizes.



Ocean invader!

The fish are made out of ¾-inch thick pine wood. They are 6 inches long and, including their dorsal fins, approximately 4 ½ inches high. The weight attached to the line is about 4 inches below the fish. In the water, the fish, line, and weight will weigh less than 8 ounces.

To learn more about fish and other “aquatic invaders” of Monterey Bay, visit the following web sites:

- Elkhorn Slough Aquatic Invaders – www.elkhornslough.org/research/aquaticinvaders.pdf
 - Monterey Bay National Marine Sanctuary list of exotic species – <http://bonita.mbnms.nos.noaa.gov/sitechar/spex.html>
 - United States Geological Service (USGS) Regional Non-Indigenous Aquatic Species Web Sites – <http://nas.er.usgs.gov/links/regionallinks.html>
3. **Killer Kelp.** Volunteer divers and dockside workers have successfully removed the invasive kelp species *Undaria pinnatifida* from a number of rocky outcroppings just outside of Monterey Harbor. Now it's time to reintroduce the native giant kelp *Macrocystis pyrifera* that had been pushed out by this invasive species.

Teams will pilot their ROVs to the bottom of the MPC swimming pool (maximum depth 12 feet) to attach the holdfasts (i.e., Velcro “loops”) of *Macrocystis* strands to a rocky outcropping (covered with Velcro “hooks”) that has been cleared of *Undaria*.

This is a timed event; each team has a maximum time of 10 minutes to attach as many strands as possible. Teams can take as many strands as their ROV is capable of carrying down at one time. Multiple trips down and back to the surface for more strands are permitted. Your team’s score is based on the number of strands of kelp that are attached to the rocky outcropping at the end of 10 minutes.

Killer kelp no more!



The contest’s *Macrocystis* strands will be approximately 36 inches long. The base of the strand will be attached to a Velcro “holdfast” that is 2 inches by 2 inches.

Undaria pinnatifida is native to Japan. Scientists believe that it made its way to California waters by hitching a ride on the hulls of ships coming from Japan. It was first noted in Monterey Harbor in 2001. To learn more about *Undaria* and the efforts to remove it from Monterey Bay, visit the following web sites:

- Seaplants Handbook – www.surialink.com/HANDBOOK/Genera/browns/Undaria/Undaria.htm
- Seaweed Invades the Bay, Monterey Herald – www.montereyherald.com/mld/montereyherald/news/8141360.htm
- Monterey Bay National Marine Sanctuary’s SIMoN (Sanctuary Integrated Monitoring Network) web site at – www.mbnms-simon.org/
- Elkhorn Slough Aquatic Invaders – www.elkhornslough.org/research/aquaticinvaders.pdf

Note: For the underwater events, we suggest that you use a viewer or “look box” to help you to see your vehicle maneuver underwater while topside. You can make your own look box using a large-diameter PVC pipe and attaching a piece of see-through acrylic or plexiglass to one end (use waterproof glue or silicone to attach the acrylic).

4. **Team Display.** Each team is required to create a display that provides information about their team and, in keeping with the contest theme, includes information about invasive species. Each team will have a space approximately 3-foot x 3-foot that will serve as its workstation as well as the arena for its display. Tables will be provided.

Team displays can include posters, papers, dioramas, and/or models and should include the following elements:

- Information about your team, including:
 - a. Team name, school, and location
 - b. Team members, sponsors or instructors, and mentors
 - c. Organizations that may have donated building supplies
 - d. What's unique about your team?
 - e. What has been the most rewarding part of this experience?
- Photos of your team and ROV, including special features of your vehicle
- A description of one or more invasive species found in Monterey Bay. Include information about how the species was introduced into the Bay and what steps, if any, are being taken to remove it. How are ROVs and/or other underwater technologies playing a role in eliminating invasive species? (Hint: You can answer this question by creating a poster, diorama, or model.)

ROV Specifications:

- Your team's ROV and control box must be built by the student team members with only advice and guidance from adult sponsors, coaches, and mentors.
- Your ROV may be built out of the materials of your choice. However, we recommend that the propellers are plastic or wood and shrouded to protect against damage to the pool surface. No parts may mar or leave a residue in the pool.
- Maximum size: Your ROV must be no larger than 16 inches (length) x 16 inches (width) x 14 inches (height). All propellers must operate under the water line.
- A 12-volt "car" battery with a 7-amp fuse will be provided. You will connect to this power source via banana jacks (female ends will be provided; you must provide the male ends). Your ROV must operate below 7 amps when underwater.
- Cameras and monitors are permitted. However, the camera(s) and monitor(s) must operate off of a separate DC battery (12-volt maximum) that your team provides. Only the camera(s) and monitor(s) are permitted to operate off of this battery; your vehicle's motors and all other associated equipment (manipulators, etc.) must be powered off of the 12-volt battery provided by the contest organizers. **NO AC POWER IS PERMITTED WHATSOEVER.**
- Radio transmitters that operate on a separate battery are permitted.
- Your ROVs will be operating in a highly chlorinated pool. Waterproofing your ROV's motors is highly recommended.

Contest Specifications:

- Your ROV must be able to maneuver in 3 dimensions and in a pool up to 12 feet deep. Seven-meter tethers are recommended.
- During the contest, your ROV may have up to three operators per team. However, there is no limit to the number of students involved in the design and construction of your vehicle.
- Only team members and contest officials are allowed poolside. Adults, sponsors, coaches, and mentors must remain behind stanchions.
- A repair table with electricity for soldering irons and other power tools will be available.

Building Support:

We want to promote this as a fun, cooperative endeavor. After the competitive events, we hope that people will share ideas. Building support information and questions should be directed to:

Kim Swan
Kswan@mbayaq.org
1-831-647-6852
Education Programs
886 Cannery Row
Monterey Bay Aquarium
Monterey, CA 93940

Contest Timeline:

Student Support Workshops Three workshops will be held for teams intending to enter the spring contest. The first two workshops will provide guidance on basic wiring and ROV design. Each team will leave these workshops with a working control box and motor assembly. Cost: \$25 for control box materials. Limit: 18 students per workshop – **you must pre-register.**

The third workshop will be a camera waterproofing workshop for Ranger class teams ONLY. Each team will leave the workshop with a waterproof camera assembly. Cost: \$15 workshop fee. Limit: 18 students per workshop – **you must pre-register.**

All workshops will take place at the Monterey Peninsula College Auto Tech facility.

- **Saturday, January 15th** – Student wiring workshop
- **February 12th** – Student wiring workshop
- **Saturday, January 29th** – Student camera waterproofing workshop for Ranger class teams.
- **Saturday, February 18, 2005** – Entry Deadline!!! Each team must submit a completed registration packet in order to be guaranteed a position in the contest.
- **Saturday, March 5th, 2005** – Pool Practice Day for registered contest participants ONLY. PLEASE RSVP (no charge).
- **Saturday, April 2nd, 2005** – Pool Practice Day for registered contest participants ONLY. PLEASE RSVP (no charge).

Saturday, April 16th, 2005 – Monterey Bay Regional ROV Contest!!!

The Monterey Bay Aquarium and the Marine Advanced Technology Education (MATE) Center will be holding the fifth annual Underwater Robotics Contest on Saturday April 16th at the Monterey Peninsula College swimming pool. Students in grades 6-12 are eligible to enter.

Additional contest information can be found at
http://www.mpcfaculty.net/mbamate_rovcontest/