

Pathfinder Class – HK ROV Regional

CONTEXT

Modern investigative science is based upon the collection and manipulation of samples. The idea of collecting things for identification, examination and classification has been around for a long time. Victorian Era science is based upon it. Chinese scholars collected and studied plants and animals way before that. Records show that Ge Hong discovered the plant *Artemisia annua* to be an effective treatment for malaria in 300AD.



Collections of large numbers of plants and animals can be found in Museums of Natural History.

The collection of samples under the sea poses very different challenges than collection from land. Aristotle (384-322 BC) researched marine animals and laid down the foundation for the investigation of the marine environment. The ancient Vikings took measurements of the sea depth and collected samples using a special weight with a hole in it connected to a rope. [Edward Forbes](#) (1815–1854) is generally regarded as the founder marine Biology as we know it today. Another prominent person who should be mentioned is Charles Darwin who studied corals and came up with several theories regarding the formation of coral reefs. Even with all of this work, marine scientists were limited by the lack of technology available to collect samples.

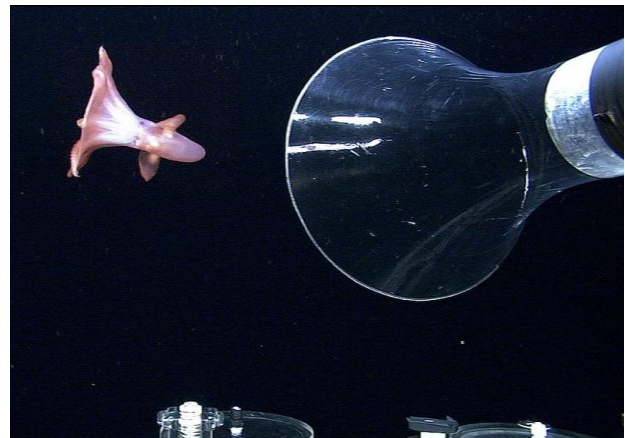
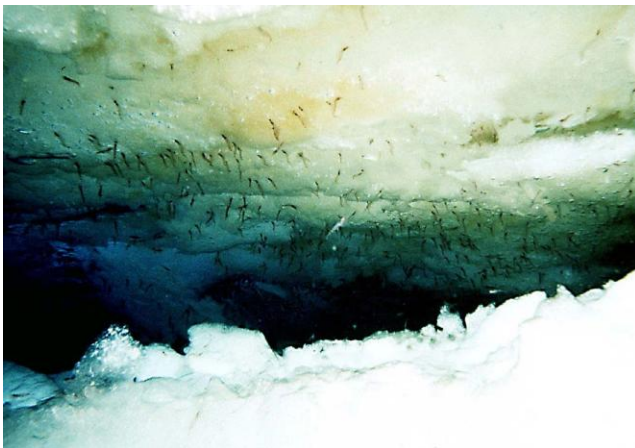
Marine Laboratories were set up to study samples collected and this encouraged technology to come up with reliable ways of collecting samples of marine organisms. This technology included sonar, scuba diving equipment, manned submersibles and ROV. The latter two inventions allowed scientists to explore deeper and deeper into the oceans.

ROVs were first designed in the USA during the 1960s. They were used for the recovery of torpedoes and mines in the 1970s by the US NAVY. They were called "Cable-Controlled Underwater Recovery Vehicle" (CURV).



An early CURV and a modern ROV.

As the development progressed and they became more reliable, their use also increased. Scientists realized that they could be used for research and collection.



ROV based research – under the Antarctica Ice Sheet and taking a deep sea sample of a Dumbo Squid.

REFERENCES

<https://www.biodiversity.govt.nz/resources/index.html>

<http://www.nhm.ac.uk/our-science.html>

<http://www.nhm.org/site/research-collections>

<http://www.mnh.si.edu/rc/>

NEED

Scientific Data Collection:

The ROV should be able to carry out an investigation of certain key or indicator species of animals in the area. Collection of corals, sea stars, sea urchins, crabs and fish should be possible using tools and mechanisms fitted to the ROV. The ROV should be able to maneuver through and around obstacles as part of the collection process.

DESIGN BRIEF

Below is a summary of the product demonstrations organized by competition class. The product demonstrations will not be separated into different runs; all five product demonstrations will be accomplished in one product demonstration run.

Scientific Data Collection

- Collect corals for analysis at the surface.
- Collect crabs for analysis at the surface.
- Collect sea stars for analysis at the surface.
- Collect sea urchins for analysis at the surface.
- Collect fish for analysis at the surface.

Maneuvering the ROV

- Passing the entire ROV under an underwater bar (frame)

SPECS

- 12 volts, 25 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power is not permitted.
- A **8m** long umbilical cable is required.
- PWM motor speed control is not allowed.
- Manually-powered hydraulics and pneumatics are not permitted.
- Maximum size limit: None.
- One person must be able to deploy and retrieve the ROV from the water.
- The operator may look in the pool to guide the ROV.

RESOURCES

Teams are permitted to use the materials of their choice provided that they are safe, will not damage or otherwise mar the competition environment, and are within the defined design and building specifications.

Teams are encouraged to focus on engineering a vehicle to complete the product demonstration tasks; when considering design choices, teams should ask themselves which one most efficiently and effectively allows them to solve the problem. Re-using components built by previous team members is permitted provided that the current team members evaluate, understand, and can explain their engineering and operational principles. Using or re-using commercial components is also permitted, provided that team members evaluate, understand, and can explain their engineering and operational principles. Teams will be questioned extensively on their overall design and component selections during their technical sales presentations.

TIME

The time given for the mission run is 10 minutes.

MISIONS

The Hong Kong Regional Pathfinder procedure & missions for 2024 will be:

3 minute setup and dismantle time. (A further 2 minutes may be requested beforehand)
10 minutes run time.

This competition is for basic ROVs. ROV fixed tools and magnets may be used. ROV's must be fitted with at least two magnets with one on the lowest point of the machine. Direct switching motor control is allowed, electro/mechanical with transistor and PWM (or similar) motor control is not allowed. Operator control feedback of this class may be camera or by looking into the pool.

The mission station will provide 12V @ 25 A power supply for the ROV. Power connection will be via 4mm banana plugs or by normal screw terminals. This class must go through the safety check with some infractions allowed. Propellers should be covered with mesh and electrical connections insulated with glue or silicon sealant. The umbilical for this class shall be 8m long.

During the completion:

- There will be a table and three chairs provided at the station.
- The table will be ~2m from the pool edge.
- Only three persons and one photographer may be forward of the table.
- Everyone else must be behind the table.
- The operators are allowed to look into the pool to steer their robots.
- All operator control feedback must be by camera.
- A single monitor with RCA Video input shall be provided at the station.
- Typical station layout is included in this document.
- There are 5 different props that have scoring, so seven missions possible.
- Two magnets will be provided to each competitor.

The Missions

1/ Collection of corals

The ROV will be fitted with a tool and / or a magnet to collect a coral. The ROV can then be returned to the pool side for surface recovery of the coral. Note that the ROV must not be dragged back to the pool by the tether. The coral retrieving person must only touch the ROV to retrieve the coral. There shall be fifteen corals per station and each coral shall be fitted with a small magnet on the top. Magnets may be used to collect the corals.

2/ Collection of crabs

The ROV will be fitted with a tool or arm suitable to collect a crab. The ROV can then be returned to the pool side for surface recovery of the crab. Note that the ROV must not be

dragged back to the pool by the tether. The crab retrieving person must only touch the ROV to retrieve the crab. There shall be two crabs per station and each crab shall be fitted with a magnetic washer on the top. Magnets may be used to collect the crabs.

3/ Collection of sea urchins

These Sea Urchins shall be "O-balls" on the bottom. The ROV will use the fitted hook or tool to catch the Sea Urchin. There shall be three "O-balls" The ROV can then be returned to the pool side for retrieval of the coral. Note that the ROV must not be dragged back to the pool by the tether. The Sea Urchin retrieving person must only touch the ROV to retrieve the Sea Urchin.

4/ Collection of sea stars

These Sea stars shall be fitted with a magnetic material that will allow collection by magnet. There shall be a magnetic disk on the sea star for collection. The ROV can then be returned to the pool side for retrieval of the sea star. Note that the ROV must not be dragged back to the pool by the tether. The Sea star retrieving person must only touch the ROV to retrieve the Sea star.

4/ Collection of fish

These fish shall be fitted with a magnetic material that will allow collection by magnet. There shall be a magnetic disk on the fish for collection. The fish shall be floating above the weight anchoring it there. The ROV can then be returned to the pool side for retrieval of the fish. Note that the ROV must not be dragged back to the pool by the tether. The fish retrieving person must only touch the ROV to retrieve the fish.

4/ Maneuvering under the bar

There shall be an 80 x 70cm "limbo bar" set up so that an ROV can navigate underneath it. No points shall be awarded if the top bar is knocked off the frame. Competitors can only attempt this once.

The Surface Work

There will be marks awarded for the surface work. The breakdown will be issued in an up-date of this document.

1/ Poster

Each Adventurer team needs to make a poster about their ROV. The theme of this shall be a reflection on the building of their ROV. This poster shall be in the Chinese or English language or a mixture of the two. The details of what this poster should contain are below:

- Title
- Photos with captions
- Illustrations and drawings
- A written description of the ROV.

2/ Reflection

Each member of the team should write one or two paragraphs about the experience of building the ROV and working with their team members. This document can be in either Chinese or English language. It may be neatly written or typed. Each reflection piece should have the name, age and school grade / class level on the first line. Several reflection paragraphs can go onto the same page provided they fit. It should have a title page with the team name on it and be bound or stapled down one edge to resemble a book. Students may include drawings or other artwork to highlight the experience. The limit for each student is one A4 page.

Scoring:

1. Collection of
 - a. Corals – 20 points per each
 - b. Crabs – 30 points per each
 - c. Sea Urchins (O-balls) – 30 points per each
 - d. Sea Stars (collection) – 20 points per each
 - e. Sea Stars (avoiding)- 30 points
 - f. Fish – 50 points each
 - g. Maneuvering under the bar – 50 total

Score Sheet

Tasks		Max
a)	20 points - Collection of corals (5)	100
b)	30 points - Collection of crabs (2)	60
c)	30 points – Collection of Sea Urchin (O-ball) (2)	60
d)	20 points - Collection of sea stars (5)	100
e)	50 points - Collection of fish (2)	100
f)	50 points – Maneuvering under the bar	50
g)	15 points - Avoiding sea stars (2)	-30
Penalty Points		
Tether Pulling - Infractions * -5		
Diver Assistance - Infractions * -5		
Leaving Debris in Pool - Infractions * -5		
Total		/500