

VOYAGE TO THE NEW WORLD

Treasure of Axolotlzuma

Description, Rules and Regulations v0.2 2013227

“My lords and ladies, I come bearing a missive from the Queen! In this year of our Lord, 1498, Her Royal Highness, Isabella Queen of Castile and Leon, Queen Consort of Aragon, Majorca, Naples and Valencia, bids you assemble a fleet and set sail at once for the new lands recently discovered by the realm’s foremost explorers. There, you are to claim its valuable and verdant expanse for Castile, and its precious resources for the Crown.

You are instructed forthwith to construct a number of worthy sea vessels with which to conduct the expedition. Her Highness has graciously granted you funds from the treasury sufficient to commission three ships suited to the task, as well as provisions for five months at sea. She is most adamant that you do not exceed her generosity.

To aid you in this duty, the court cartographer has prepared a map of the ocean and coastline you will be traversing. Likewise, the court astrologer has provided you with a celestial chart of the stars in the heavens above the new lands. With these, you will be able to cross the seas and navigate the coast until you reach lush and productive farmlands to seize.

But be warned, my lords, my ladies – the passage to the new world is fraught with danger and peril. It is said that across the ocean ash and soot falls from the skies – that strange winds blow unpredictably – that giant sea monsters devour ships whole! This is not an enterprise for the faint of heart or cowardly of disposition.

However, with great risk comes great reward. It is also said that deep within the jungles of the wild new land, there is a pyramid temple constructed by the natives in honour of their terrible god-king Axolotlzuma. Washed by the blood of a thousand sacrifices, it is said that Axolotlzuma buried his most valuable treasure in this temple, and that whoever should recover it will wield its power. But that’s just stories... perhaps.”

Task Description

The objective is to build a small autonomous vessel that automatically navigates from one side of a shallow water tank to the other, navigate obstacles and make landfall on a coastline, propelled only by the wind. This document lays out the rules of the challenge, describes key concepts, and lists permitted materials and specific prohibitions. The “team” is any and all students in a group working on the project. The “judge” is the course coordinator or staff member adjudicating the project demonstration.

Voyage attempts

Each team has three “ships” – that is, three attempts to reach the new world. The result scored will be the highest of the three attempts. At the start of each attempt, the ship shall be placed in the port at the starting side of the map. Timing will commence when the wind source is engaged. The ship must leave the port under its own power and navigate to the scoring regions on the other side of the map. No human input is permitted during an attempt.

Points are awarded according to the location on the coastline, or islands, where the ship makes landfall. If the hull of the ship touches dry land at any time during the attempt, the team may declare it has 'landed' and accept the score indicated by its location, ending the attempt. The team may elect not to declare landfall and allow the ship to continue navigating. The ship must travel by water at all times; travel over land or through the air will forfeit the attempt.

A ship that reaches a port (including its home port) may reset its attempt timer; this may be done only once per attempt. A ship that becomes snagged may be freed by the judge at the request of the team, at the cost of a penalty.

Teams may elect to undertake the voyage during the 'summer' or 'winter'. Summer voyages have constant wind power and direction. Winter voyages have variable wind power and direction.

Scoring criterion

Points are awarded for landfall location and special achievements. Points awarded are as per the tables below. The landing location scored shall be the highest scoring region of dry land that the hull of the ship touches. The judge shall be the final arbiter of which scoring region the ship has landed upon. If the ship does not make landfall within the time limit, the attempt is forfeit and no score shall be awarded. The judge shall be the final arbiter of points awarded.

To be eligible for achievement points, the vessel must have a Seaworthiness Certificate for demonstrating minimum functionality. Vessels without the certificate may still score points by landing in scoring regions.

Landfall location	Points
Lost at sea	NA
Island	2
Desert	3
Forests	4
Farmland/river	5

Achievement	Points
Winter attempt	1
Reached the Temple of Axolotzuma	2
All ships reach river delta or farmland	1
No off-board computation	1
\$20 under budget	1
Snagged ship freed by judge	-1

Time limit

Each attempt is permitted 5 'months at sea' – that is, 5 minutes – to travel from the port to the other side of the tank. If the ship has not made landfall within 5 minutes, the attempt is forfeit. If the ship is touching dry land at the time limit but the team has not declared landfall, landfall shall be declared automatically and the appropriate score awarded.

The Map

The map represents the entire navigable area of the water tank, and its landmasses. The tank shall be 4m long by 2.1m wide and up to 150 mm deep. The subsurface terrain gradually rises to zero depth at the shore line. It encompasses the Port, the Coastline, Islands, and the edges of the tank. It also includes special features such as hazards and the Temple of Axolotlzuma. In addition to surface features, the landmasses include substantial submarine topography.

Ports

All ships start in the home port, in the centre of the 'home' side of the map. At the start of an attempt, the ship must leave the port on its own, without intervention. If the ship reaches a port, it may take on provisions and reset its 5 minute timer. A ship may replenish only once, at any port. The ship may be reoriented while in port (to face a different direction), but must leave the port on its own.



Coastline

The coastline is the contiguous strip of land on the 'far' side of the map. It is divided into several scoring regions: Island, Desert, Forrest, Farmland and River delta. The river extends some way inland, up to the Temple of Axolotlzuma. A continental shelf extends away from the shore of the coastline, and incorporates the Islands.



Islands

The islands are isolated landmasses. They are valid scoring regions, including the Volcano.

Hazards

There are several traps and navigation hazards scattered through the map. Ships are strongly cautioned to avoid them.

- Here There Be Dragons
The dragon will eat your ship! Running into the dragon forfeits the attempt. The dragon will be placed randomly within the tank, in the vicinity of the region marked on the map.



- The Volcano
Lava flows out of the volcano and into the sea, disturbing passing ships.
- The Edge of the world
Strange things happen at the tank's edge – beware snags and doldrums!



- Shallows
Close to the shore and around the islands, the submerged terrain nears the surface. This poses a navigation challenge for deep-keeled ships. The river and river delta are especially shallow.

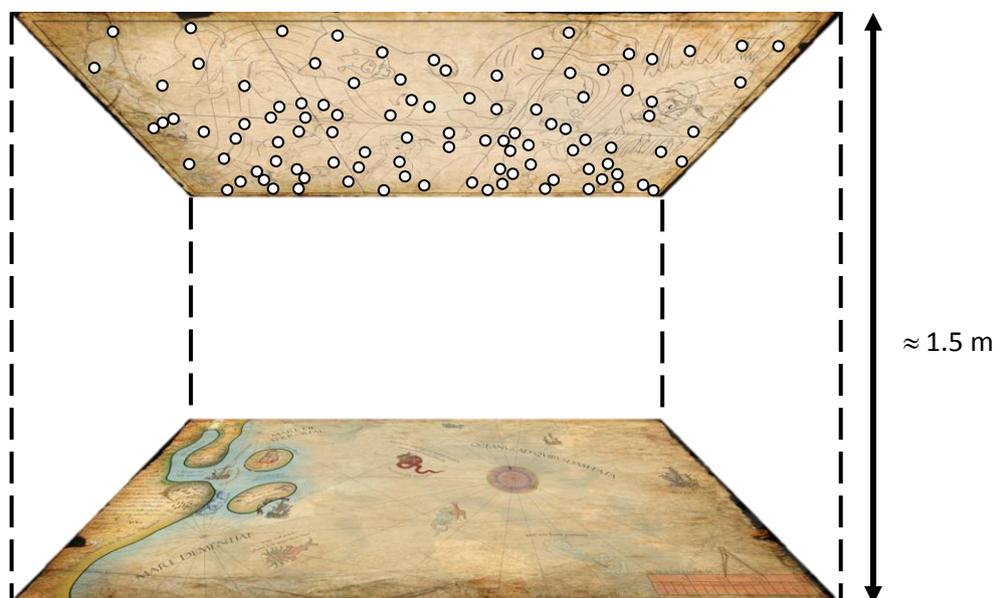
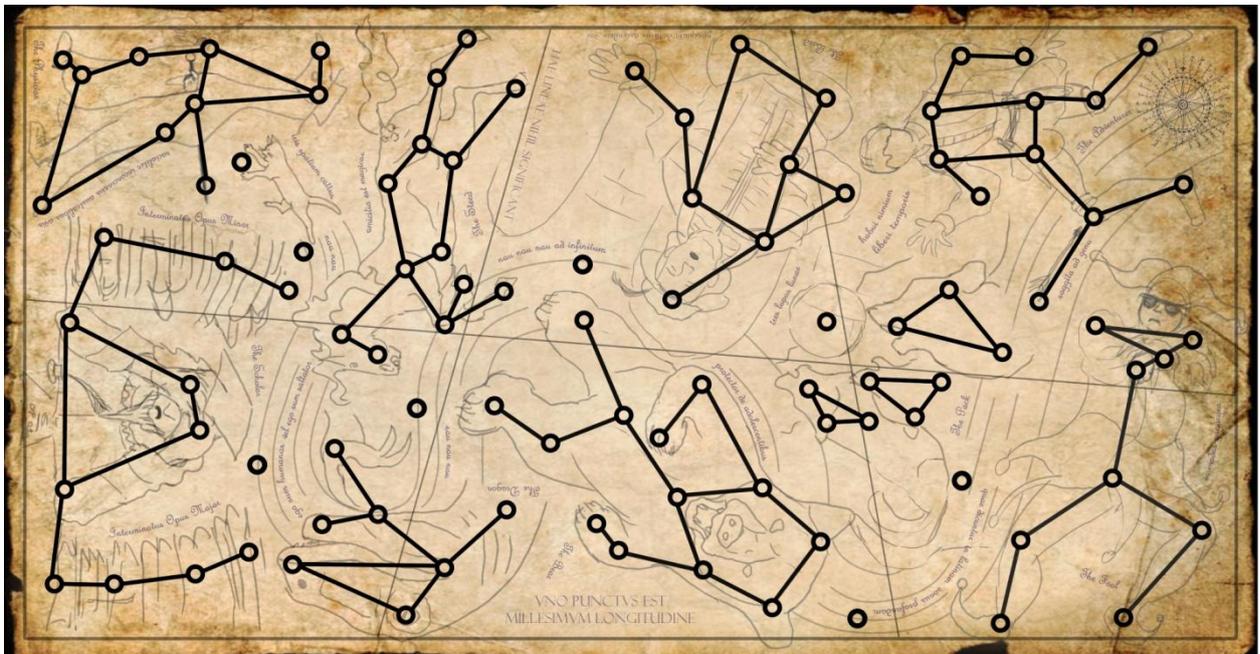
Temple of Axolotzuma

The Temple of Axolotzuma lies far inland at the head of a shallow river. Deep in the jungle, swathed in vines, legend says it contains a valuable treasure – a mythical idol of solid gold in the fierce form of Axolotzuma himself! Successfully navigating the river delta to reach the temple practically guarantees a high score.



The Star Chart

Mounted directly above the tank is a panel set with an array of LED lights, representing stars to guide the vessel. The stars are configured into constellations, as depicted on the star chart. The star chart scale is the same as the nautical map: one pixel represents one millimetre. The star chart is inverted with respect to the nautical map – it represents the stars as viewed from the ground. The compass rose is correspondingly reversed. Distance between the stars and the water line will be approximately 1.5 m, but is inexact and subject to change without notice.



Vessels

Each team has three 'ships' (three attempts) but constructs only one actual physical vessel. It is permissible to modify the vessel between each attempt, provided the modifications fall within the rules (including budget restrictions).

Dimensions and Construction

The dimensions of the vessel's hull must be less than 150 mm long by 75 mm wide, from below the waterline to up to 20 mm above the waterline. The home port shall have the dimensions of the largest permissible vessel hull – a vessel that cannot fit within the port is ineligible for an attempt. Any structure of the vessel extending beyond these limits is not considered hull for scoring purposes. The vessel may have any draft, such that the vessel remains afloat. The vessel must support its own weight with water buoyancy. The judge shall be the final arbiter of whether a vessel is legal, and what parts of it constitute its hull. The vessel may be constructed from any material.

Propulsion and Equipment

The vessel must be driven by the wind. That is, the **propulsive energy must come from the wind alone**. It is permissible to power on-board electronics with a battery, but it may not power any propulsive effort – this includes the action of control surfaces or sails; e.g. no “rudder wagging” flagellum propulsion. Energy storage devices, e.g. capacitors charged by wind turbines, are permitted, but they must start fully discharged and unpowered. The judge may elect to have the discharged state of any energy storage device demonstrated prior to an attempt.

The vessel may be equipped with any item not explicitly prohibited, up to the budget limit. The vessel may include communication links to off-board computational facilities to allow remote processing and control.

Budget

The total cost of materials, parts and components incorporated in the vessel shall be no more than \$150. Regardless of actual cost to construct, the team must demonstrate that the vessel produced *could* be constructed from \$150 of parts. Up to \$150 will be provided for purchase orders through ETSG. **Reimbursements will not be permitted.**

Cost of parts shall be calculated on a per-item basis; parts that are purchased in multiple units may be costed per unit – e.g. a bag of 10 nails for \$10 may be charged at \$1 per nail used. Bulk unit discounts from suppliers may be applied, provided the quantity of items used in the vessel is sufficient to earn the discount. Items sourced for free (i.e. not paid for) may be costed at half the as-new purchase price. While it is not necessary to have circuit boards manufactured at ETSG, any boards produced by outside fabricators must be purchased via ETSG's order system.

Seaworthiness Certificate

To be eligible for achievement points, a vessel must demonstrate basic functionality to earn a “Seaworthiness Certificate”. Minimum functionality consists of crossing 2m of open water upwind, powered by the wind.

Specific Prohibitions

- **No human input**

Remote control, teleoperation or other input devices must be removed or disabled prior to the start of an attempt. The judge may elect to have the disabled or removed state of any input device demonstrated prior to an attempt. The judge shall be the final arbiter of whether the steps taken to disable a device are adequate.

- **No off-board sensing**

Only sensors mounted on the vessel may be used to determine the state of the map, vessel and environment. Sensors on off-board computers, such as webcams, must be disabled. The judge may elect to have the disabled status of any sensor demonstrated prior to an attempt. The judge shall be the final arbiter of whether a sensor is adequately disabled.

- **No markers or alterations**

No signs, structures, markers, radio beacons or other equipment may be employed beyond those provided by the tank arena and star map. No alterations may be made to the tank, its contents or the star map. Ships that cause damage to the coastline may be disqualified.

- **No internet connection**

The vessel may not be connected to the internet, nor may any off-board processing facility be connected to the Internet. Where Wifi or similar wireless protocols are used to connect between the vessel and another computer, it must be demonstrated that no computer on its network is connected to the Internet. The judge may elect to have the connection status of any input device demonstrated prior to an attempt. The judge shall be the final arbiter of whether a connection constitutes connection to the Internet.

The Aim of the Project and the Spirit of the Rules

Without a doubt, engineering students are extremely creative and talented at finding clever solutions to difficult problems. This project aims to teach you about the practical trade-offs encountered by real engineers when facing a multi-faceted challenge with broad scope and many possible solutions. It is recognised that no set of rules could cover every possible edge case without becoming cumbersome fodder for 'rules lawyers'.

Thus, the two cardinal rules are:

1. Judge's discretion is final.
2. Stay within the spirit of the problem.

If you think what you are attempting might not be in accordance with the spirit of the rules... it probably isn't. However, there is no harm in asking! The judge will determine whether a particular approach is permissible. It is best to ask these sorts of questions early in the semester!

Other Miscellanea

By-laws, clarifications and addenda go here.

1. All OH&S inductions and procedures *must* be adhered to. You **WILL** be ejected from the lab if you are unsafe or in violation of footwear requirements. Repeat offenders will be barred from the teaching labs for the remainder of the semester.
2. It is the responsibility of all students to keep the teaching labs in clean, functioning condition. Lab cleanliness will be arbitrated by a warning system, as posted on the class blackboard site and class website. The lab status starts at GREEN. If the condition of the labs deteriorates and becomes too messy, status will change to YELLOW, indicating that clean-up is needed. If lab condition does not improve or deteriorates further, the status will be changed to RED and the labs will be locked to students until the next practical session, whereupon the labs must be completely cleaned before any work may resume.
3. 'Vegas rules' are in effect: what happens in c404/c403 *stays* in c404/c403. Under no circumstances may project infrastructure, test equipment, tools, supplies, furniture, etc. be removed from the teaching labs.
4. No grade will be awarded until all assigned tools and equipment are returned and accounted for.