

The 2011 EcoBot Challenge Tasks

This year's challenge is about water, resources, and energy generation: the Port of Houston and the Ship Channel; importing and exporting raw materials and finished goods; and eVgo rechargeable electric energy and generating energy from tides. The 2011 EcoBot challenges will enable teams to have an exciting hands-on experience with these environmental opportunities. Through your preparation for these challenges, your teams will have a unique and fun opportunity to better understand the environment in which we live while developing their science, technology, engineering, and math skills. Prepare to be challenged!

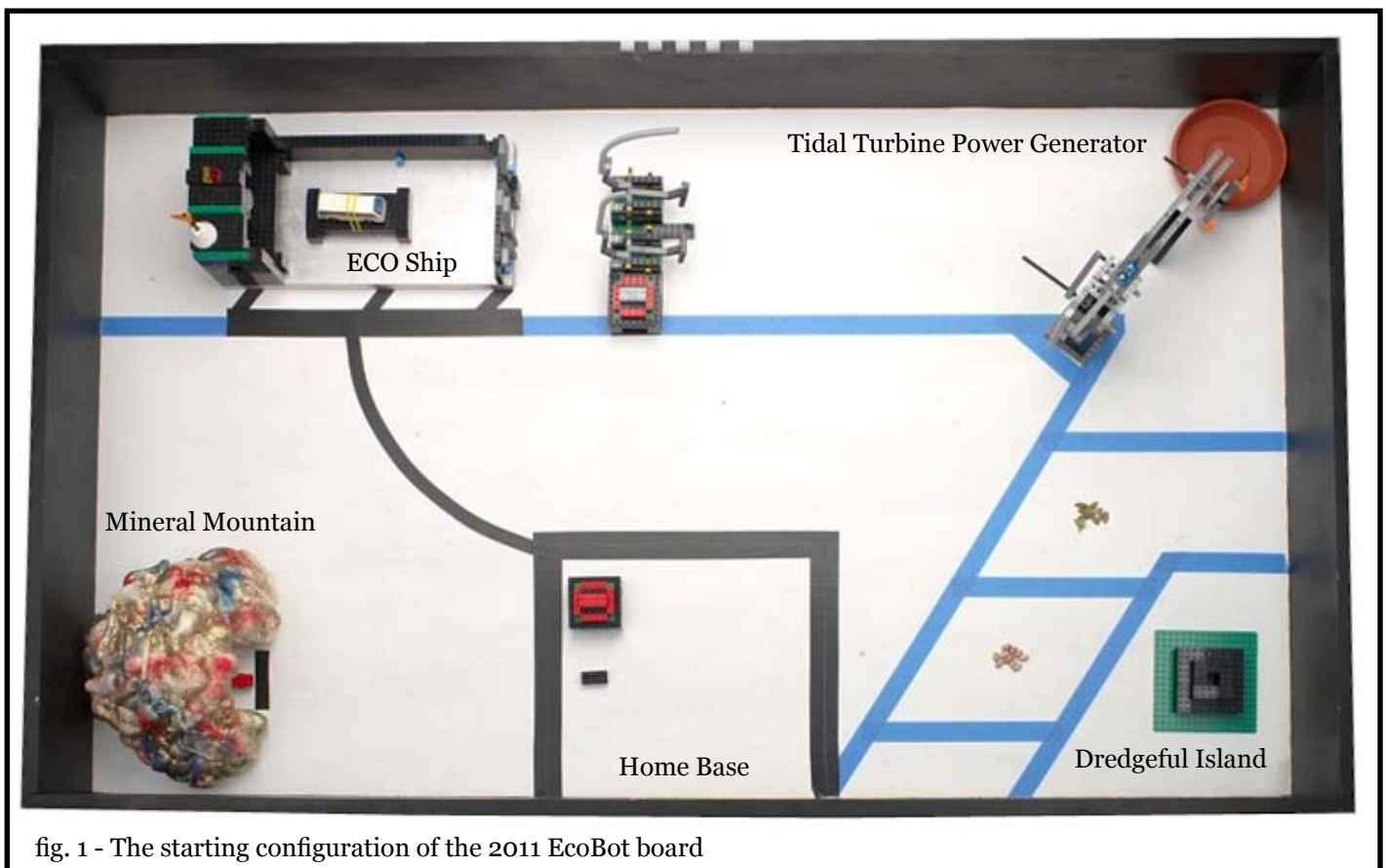


fig. 1 - The starting configuration of the 2011 EcoBot board

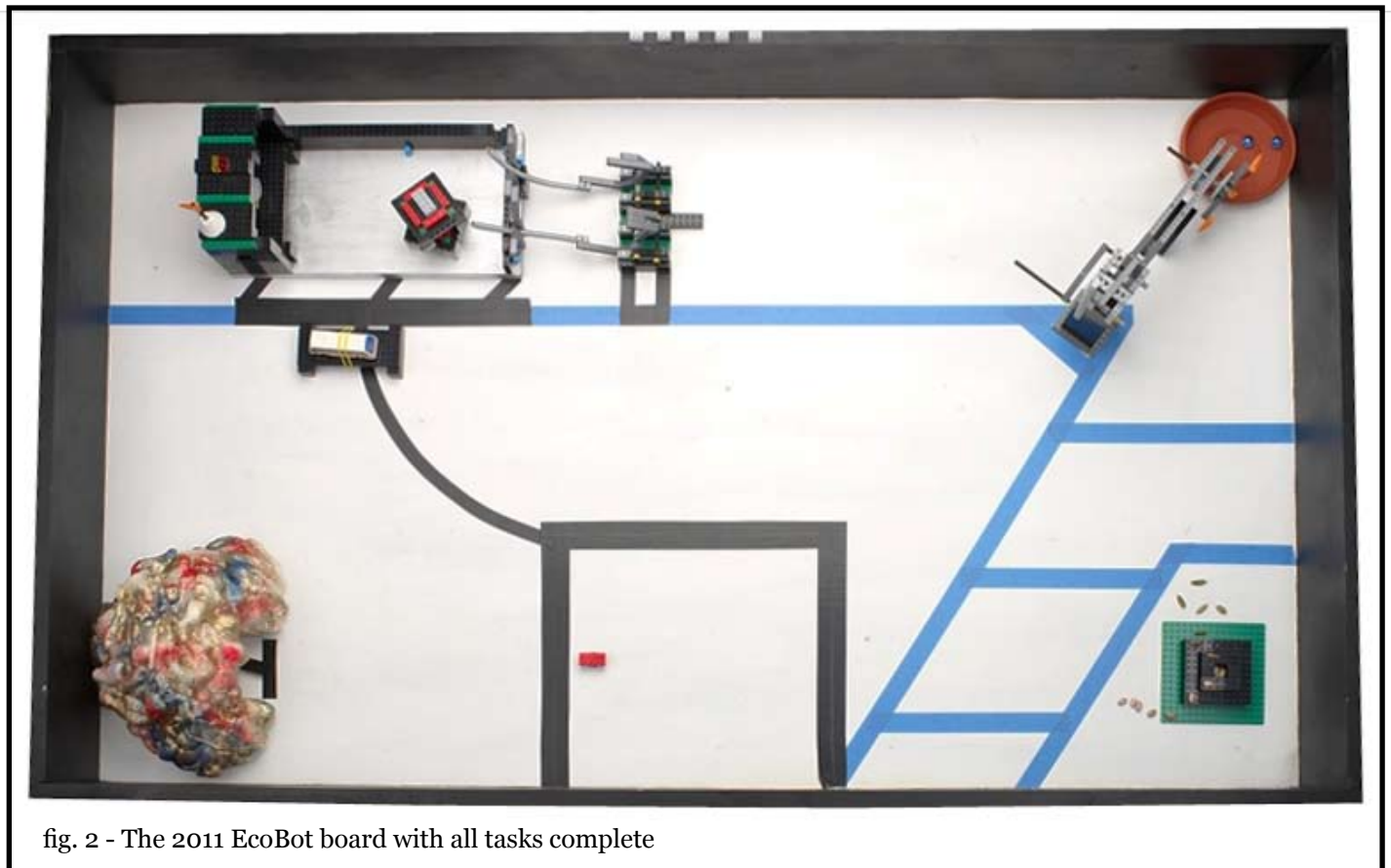
This year's challenges are (going clockwise from the left of Home base):

- Mineral Mountain
- ECO Ship
- Tidal Turbine Power Generator
- Dredgeful Island

Important Guidelines:

The robot must begin completely inside Home.

Teams will start each competition round with five “power cells” (represented by 2x4 bricks) each worth 5 points. Each time the robot is touched and/or moved back to Home, the team will lose one of the “power cells.”



Mineral Mountain

At Mineral Mountain, people are using robots to mine bauxite ore. This ore will be processed to extract the aluminum so it can be manufactured into many different products, such as car and motorcycle parts, airplane bodies, cans, light bulbs, and more.

For this task, the team's robot must deliver supplies to the miners and then retrieve the aluminum ore.



fig. 3 - Starting configuration of Mineral Mountain. Notice the magnetic bauxite ore (red brick) in the cave that can be removed with the wing nut.



fig. 4 - Mineral Mountain tasks complete. Notice the supply container (black brick) in the cave.

Task Set

A: Deliver supplies (water, food, and tools): 10 points.

Transfer the supply container (2x4 LEGO brick) from Home to the mountain.

(To score, the Supplies pod must be pushed into the cave and must cross over the left side of the tape at the entrance.)

B: Retrieve aluminum ore: 20 points.

Remove the ore from the mine and bring it back to Home. (To score, any part of the ore pod must end up inside the tape around Home.)

The ore in the mine is a 3/4" magnet placed directly in the middle of the cave. Your team should use a 3/8" wing nut to attract the magnet out of the cave and drag/lift/pull the magnet back to Home. You may attach the wing nut anywhere on your robot.



Mineral Mountain Building Notes

Magnet inside of cave:

3/4 Round Craft Ceramic Magnet found at Hobby Lobby

Item number 1006. If you can't find this, a magnet that is close to this size will be a good alternative. Don't forget to place the magnet directly in the middle of the cave.

Wing Nut:

3/8" – 16 zinc wing nut. This is a very common hardware store object.

When you are practicing, you may use anything you want to build the cave, such as LEGOs or cardboard. Just remember to keep your cave the same dimensions as what the measurement guide shows.

You don't have to add the spray foam. Just make sure to be aware of the size of the mountain for the competition.

Spray foam is a hazardous material, so please use under teacher/coach supervision.

Look at the illustrated guide to understand how much table space the mountain occupies.

Wing nut can be attached to any part of your robot

ECO Ship

The Port of Houston is 25 miles long. In 2009, more than 220 million tons of cargo moved through the Port. That same year, more than 7,700 vessels called at the Port. It's an important center of international importing and exporting.

In this task area, one of the first electric-powered cargo ships in the world has docked. It must be re-charged using the eVgo ship charging station so it can deliver and pick up its cargo.

The dock area is indicated by the black tape in front of the ship.

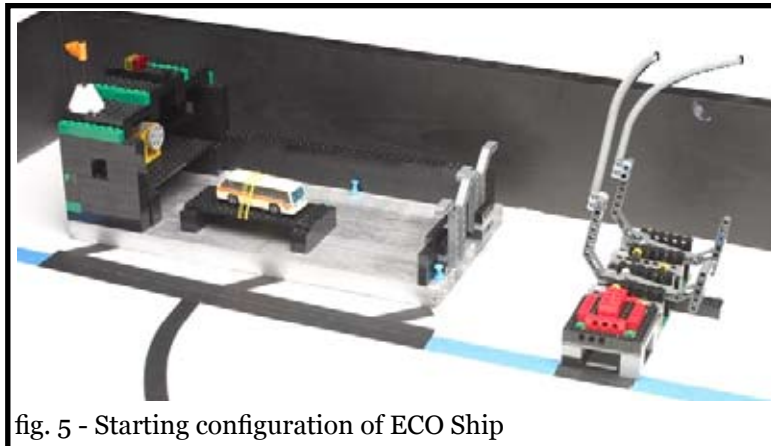


fig. 5 - Starting configuration of ECO Ship

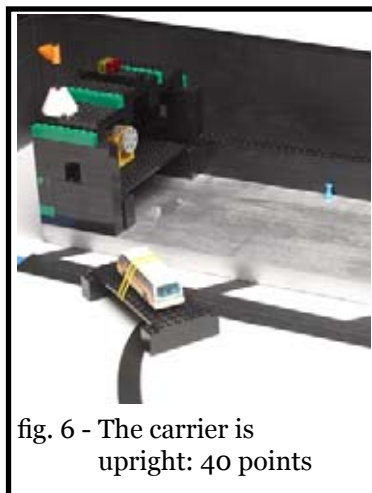


fig. 6 - The carrier is upright: 40 points

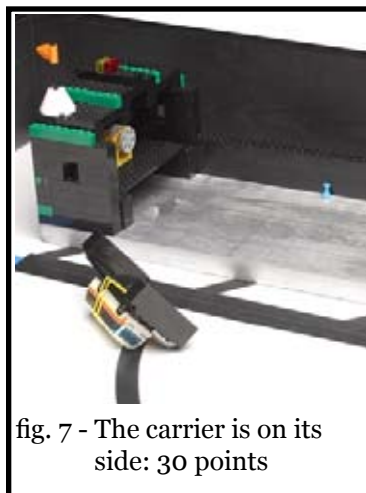


fig. 7 - The carrier is on its side: 30 points

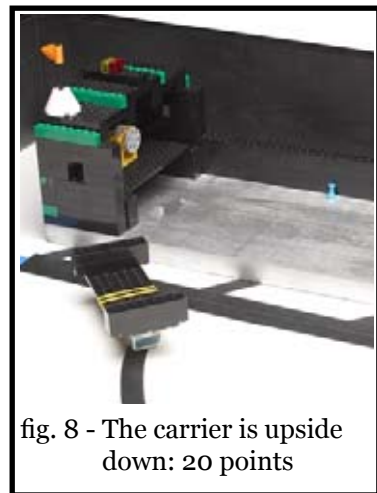


fig. 8 - The carrier is upside down: 20 points

Task Set 1: Unload Cargo - Energy-Efficient Electric Cars (imported cargo)

Pick up car carrier from ship and set it on the dock area.

(To score points, the carrier must end up on the tape representing the dock, or on the white area adjacent to the tape).

Carrier remains upright: 40 points

Carrier lands on its side: 30 points

Carrier lands upside down: 20 points

ECO Ship (continued)

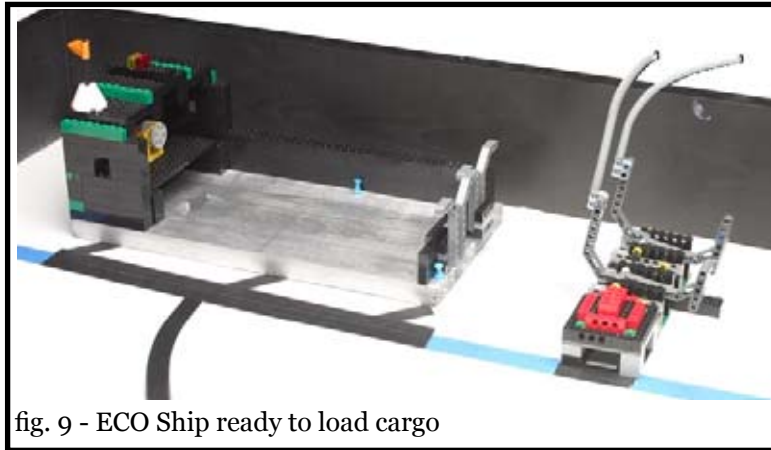


fig. 9 - ECO Ship ready to load cargo

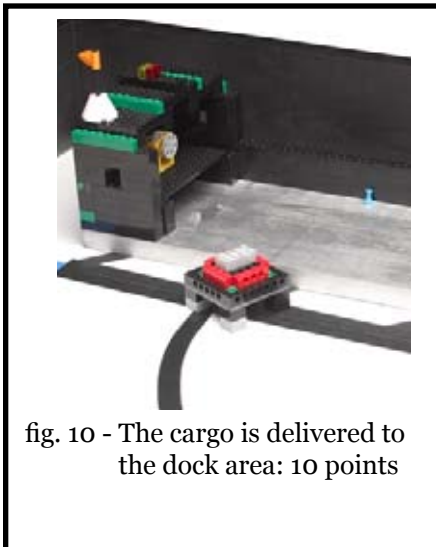


fig. 10 - The cargo is delivered to the dock area: 10 points

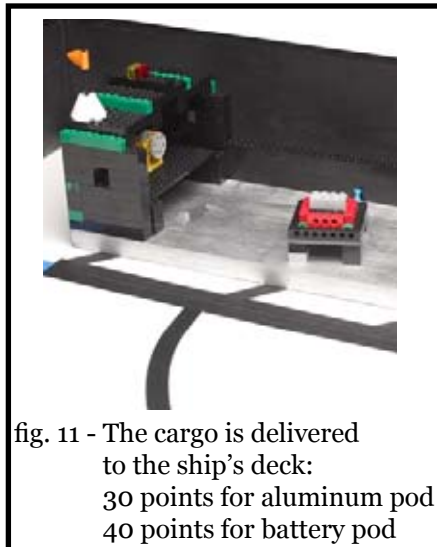


fig. 11 - The cargo is delivered to the ship's deck:
 30 points for aluminum pod
 40 points for battery pod

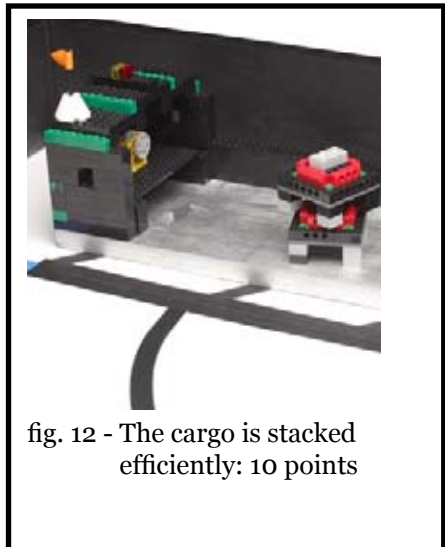


fig. 12 - The cargo is stacked efficiently: 10 points

Task Set 2: Load Cargo - Processed Aluminum and Charged Battery Cell (exported cargo)

A: Take processed aluminum pod from Home and deliver to ship.

Deliver it to dock area: 10 points

Deliver it to ship's deck: 30 points

B: Pick up charged battery pod from dock and deliver to ship.

Deliver to dock area: 10 points

Deliver to ships deck: 40 points

BONUS POINTS: Use cargo space efficiently by stacking cargo pods on ship.

Receive a 10-point bonus if either one of the pods is stacked on top of the other so that the top pod is not touching the ships' deck.

ECO Ship (continued)

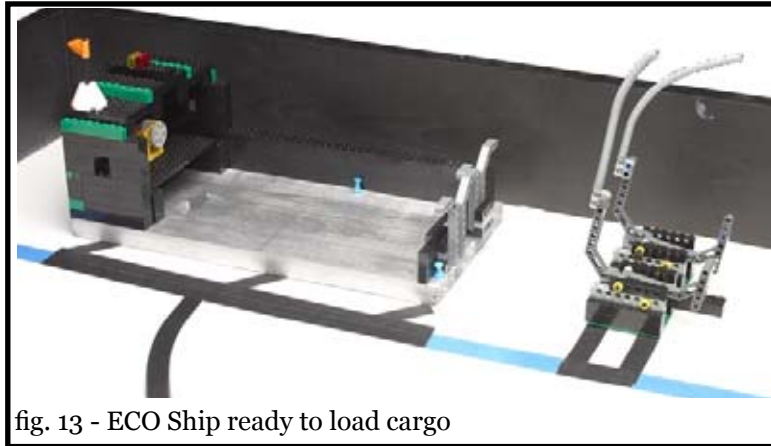


fig. 13 - ECO Ship ready to load cargo



fig. 14 - The eVgo lever is engaged - 20 points

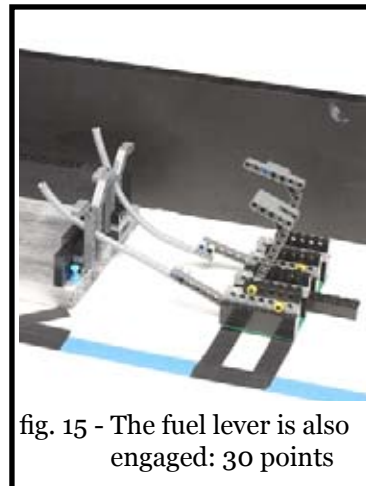


fig. 15 - The fuel lever is also engaged: 30 points

Task Set 2: Re-power ship at eVgo and fuel docking station

A: Engage eVgo lever by dropping flexible feed cord into chamber (closest to home): 20 points.

B: Engage fuel lever by dropping flexible feed cord into chamber (furthest from home): 30 points.

* Lever must break the plane of the docking station in order to score points.



ECO Ship Building Notes

The base of the boat is a 1"x8" board that is cut 14.5" long. We spray painted it silver. If you are practicing, you don't have to spray paint or build the stern. It is important that you have a 10.5" x 6" dock area to practice with. Home Depot or Lowes has a "cull" lumber area where they sell slightly damaged lumber for extremely low prices. We recommend finding your boards there. They will even cut it to size for you.

If you build the LEGO wall on the boat, you could place thumbtacks in the wood to hold the LEGO wall in place.

The dock area "loading and unloading area" of the boat is 10.5" x 6" inside the LEGO walls.

ALTERNATIVE BUILDING OPTION: The stern (west end) of the boat is 3" and reserved for you to build (if you would like) a cool-looking helm area. The helm area should not be any taller than 6.5" from the table.

Tidal Turbine Power Generator

To bring clean energy to the Port of Houston, we have developed a electricity-generating system using the power of the tides. This generator works much like a dam: as the tide moves from low to high and high to low, water rises and falls through the generator, producing electric energy. Nature provides this opportunity twice a day, thanks to the gravitational pull of the moon. In this task, your robot will bring the new Tidal Turbine Power Generator online.

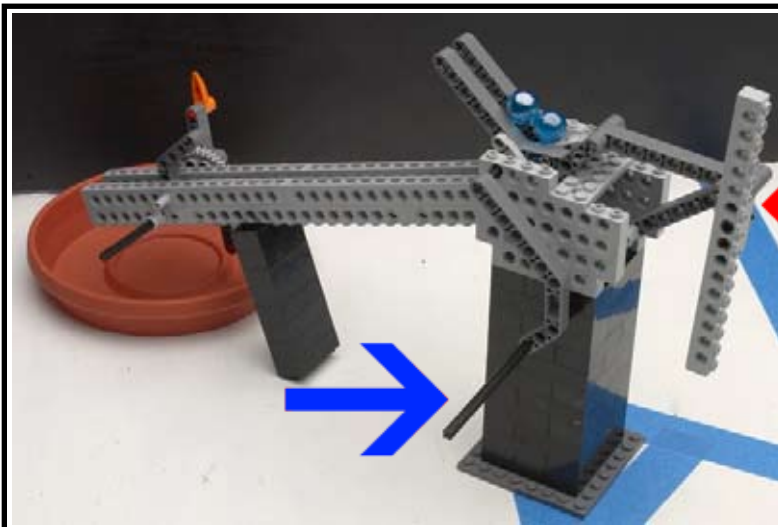


fig. 16 - The Tidal Turbine Power Generator ready to be activated

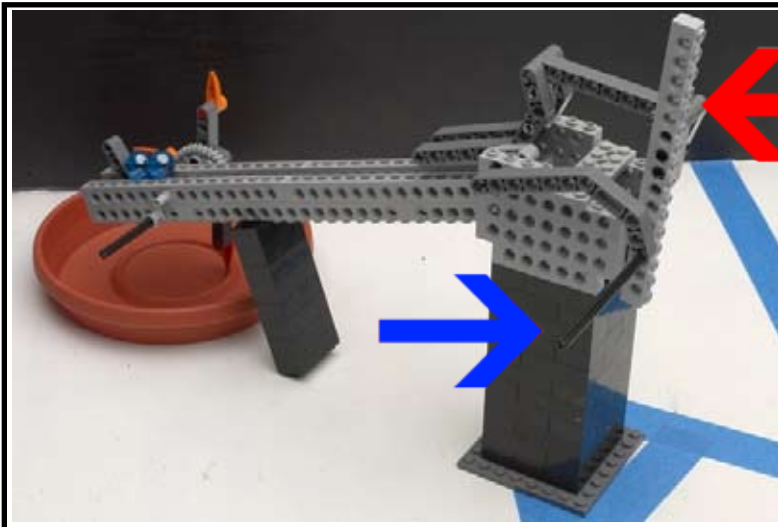


fig. 17 - The Tidal Turbine Power Generator in action

Red Arrow: If the generator is activated via the push mechanism - 10 points.

Blue Arrow: If the generator is activated via the pull mechanism - 30 points.

Task Set

Activate Generator.

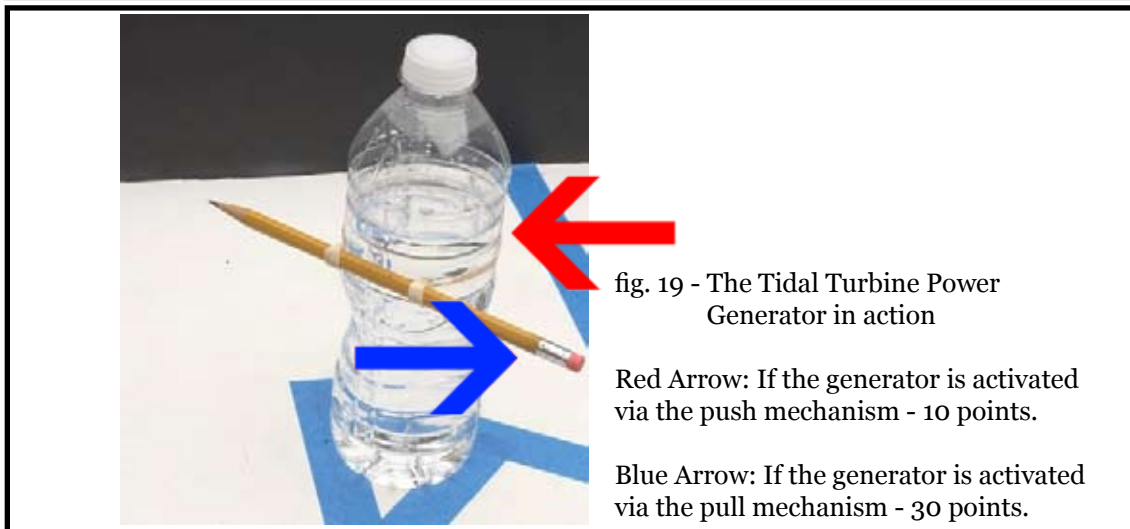
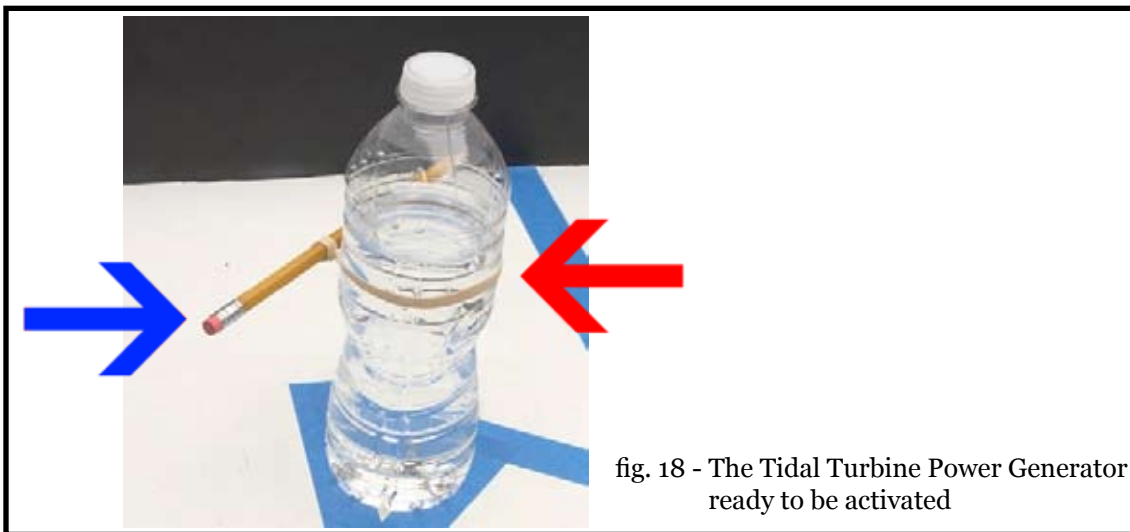
(Falling water is represented by marbles. At least one marble must roll down the chute and spin the generator to score points.)

Activate using forward release (push) mechanism: 10 points.

Activate using reverse release (pull) mechanism: 30 points.

Tidal Turbine Power Generator Building Notes

ALTERNATIVE BUILDING OPTION: You can use a water bottle, a pencil and a rubber band as shown below. If your robot is able to push the water bottle, this is the same amount of force that is needed to push in the LEGO-built vertical arm mechanism worth 10 points. If your robot is able to pull the horizontal pencil attached to the middle of the bottle hard enough to make the bottle turn 90 degrees counter-clockwise, this is sufficient force to earn the 30 points on the LEGO-built pull mechanism.



Dredgeful Island

Ships come to the Port of Houston from all over the world and they all pass through the Houston Ship Channel. Because the Ship Channel connects the Port to the Gulf, tides push silt and other material up the Channel. Water causes erosion at the sides of the Channel. All of this dirt builds up at the bottom of the Channel, and would eventually make it difficult or impossible for big ships to travel to the Port if the material wasn't removed.

Therefore, robotic dredging machines must widen and deepen the channel to clean out accumulated material and to make room for the larger tankers of the future. We'll use the dredged soil to build Dredgeful Island to be used as a wildlife sanctuary, recreational area, and sport fishing area. This way, we are reusing material to create something that benefits the region.

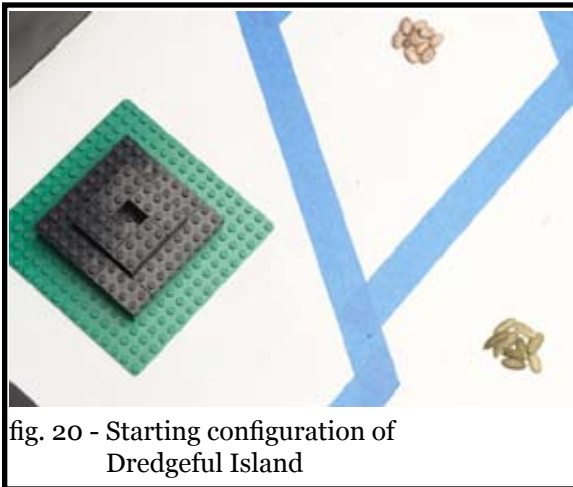


fig. 20 - Starting configuration of Dredgeful Island

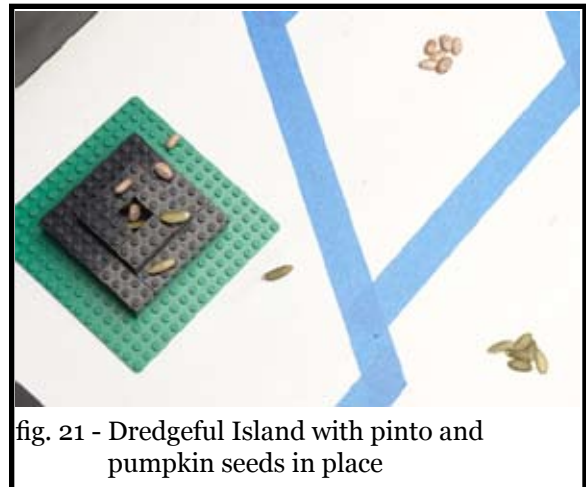


fig. 21 - Dredgeful Island with pinto and pumpkin seeds in place

*Task Set: Move dredging material to Dredgeful Island
 (Shore includes the white area around the base plate and the base plate itself.)*

A: Widen the Channel — pinto beans

- Move any pinto bean to the shore of the island: 5 points.
- Move any pinto bean to level one of the island: 10 points.
- Move any pinto bean to level two of the island: 15 points.
- Move any pinto bean into the hole at the top of the island: 20 points.

B: Deepen the Channel — pumpkin seeds

- Move any pumpkin seed to the shore of the island: 10 points.
- Move any pumpkin seed to level one of the island: 20 points.
- Move any pumpkin seed level two of the island: 30 points.
- Move any pumpkin seed into the hole at the top of the island: 40 points.

IMPORTANT NOTE:

Teams earn points for only the highest level where they put a pinto bean or pumpkin seed.
 Teams are allowed to bring beans/seeds Home before completing task.



Scoring

Scoring for tasks during a round will be the highest score that a team achieves for a given task. For example, if there are two ways to score on a task — 5 points for achieving the easier level, and 10 points for achieving the more difficult level — and the team successfully achieves both levels, they will receive points for only the more difficult level. In this example, if the team attempted and succeeded at both levels, the team would receive 10 points. This specifically applies to Dredgeful Island.

If you are finished running your robot before time is up you may tell the judges that you are done and they will add up your score.

Scoring will take place at the time of the action. If robot undoes a task, points will not be subtracted.

There are multiple opportunities for your team to score points:

- Mineral Mountain contains 2 different opportunities to earn up to 30 points.
- Eco Ship contains 6 different opportunities to earn up to 170 points.
- Tidal Turbine Power Generator contains 2 opportunities that will provide either 10 or 30 points.
- Dredgeful Island contains two opportunities to score up to 60 points.
- If the robot is not touched and/or moved back to Home, 5 power cells provide 25 points.

Total Possible Points in One Round =315



Concepts

STEM (Science, Technology, Engineering, and Math) skills will be used frequently throughout your preparation and the event itself.

Energy:

- Generating power from tides (Tidal Turbine Power Generator)
- Electric-powered cars (ECO Ship)
- Electric-powered ship (ECO Ship)
- Magnetic Force (Mineral Mountain)

Import/Export:

- Electric-powered cars (ECO Ship)
- Aluminum/ore (Mineral Mountain)
- Other goods (ECO Ship)

Engineering:

- Dredging channel (Dredgeful Island)
- Building island with dredged material (Dredgeful Island)
- Generating power from tides (Tidal Turbine Power Generator)

Environmental:

- Dredging channel (Dredgeful Island)
- Building island with dredged material (Dredgeful Island)
- Generating power from tides (Tidal Turbine Power Generator)
- Using rechargeable batteries and electric powered vehicles (ECO Ship)

Key Words

Port of Houston

The Port is a 25-mile-long complex of facilities located a few hours' sailing time from the Gulf of Mexico via the Houston Ship Channel. It is the busiest port in the U.S.A.

Houston Ship Channel

The Ship Channel is part of the the Port of Houston, linking the Port to the Gulf of Mexico.

eVgo

eVgo is a dedicated ecosystem of electric vehicle charging docks and network charging stations united by affordable, set-rate charging plans from energy industry leader NRG.

Import

Bring goods to our country from other countries.

Export

Send goods from our country to other countries.

Clean Power

Energy that, when it is generated, doesn't pollute the environment, such as wind, tidal, solar, etc.

Magnetic Force

Magnets exert forces and torques on each other due to the rules of electromagnetism.

For building instructions, board dimensions and additional information, visit the EcoBot website at www.ecobotchallenge.com.