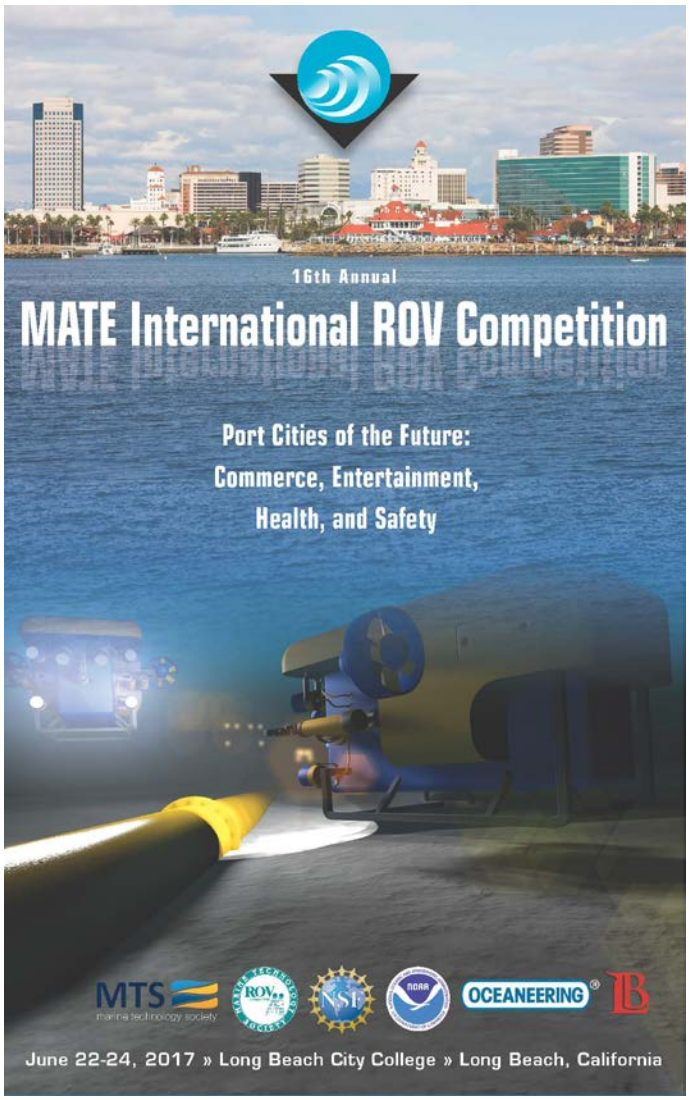
2017 MATE ROV COMPETITION: NAVIGATOR CLASS PREVIEW MISSION



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NAVIGATOR Class Preview Product Demonstration
Port Cities of the Future: Entertainment

With its kaleidoscope of colors, fanciful music, and more than 1,000 fountains shooting water 100 feet into the air, the port's water and light show, *a-MATE-zing*, is a spectacular blend of art and technology. It is also a hugely popular nighttime attraction, which makes maintaining it to ensure uninterrupted operation a priority.

The show is due for routine maintenance. Specifically, one of the water fountains needs to be removed and replaced. The fountain is located in the center of the show's primary platform.

You are tasked with piloting your ROV to the platform to disconnect the power cable and turn a valve to stop the flow of water. Then you must remove the old fountain and install a new fountain. After installing a new fountain, you must reconnect power cable and turn the valve to restore the flow of water. You must also return the old fountain to the surface.

References
https://disneyland.disney.go.com/entertainment/disney-california-adventure/world-of-color/

This task involves the following steps:

- **Disconnecting the power cable from the platform – 5 points**
- **Turning the valve to stop the flow of water to the platform – 10 points**
- **Removing the old fountain – 5 points**
- **Installing the new fountain – 5 points**
- **Turning the valve to restore the flow of water to the platform – 10 points**
- **Reconnecting the power cable to the platform – 10 points**
- **Returning the old fountain to the surface, side of the pool – 5 points**

TOTAL POINTS = 50

Product Demonstration Notes:
Companies must first disconnect the power cable and turn the valve to stop the flow of water. These two steps may be done in any order, but must be completed before continuing to the other steps of this task. Companies must remove the old fountain and install the new fountain. These two steps must be done in order. After installing the new fountain, companies must turn the valve to restore the flow of water and reconnect the power cable. These two steps may be done in any order. Companies must also return the old fountain to the surface. Returning the old fountain to the surface may be done at any time after removing it from the platform.

The entertainment platform will be constructed out of a PVC frame with corrugated plastic attached to the top. The framework will rest on the bottom of the pool. The platform is approximately 1 square meter in length and width, and 0.4 meters tall.

Companies must disconnect the power cable from the platform and turn the valve to stop the flow of water to the platform. The power cable will be located on the outside, bottom corner of the platform frame. The valve will be located on the outside perimeter of the platform frame as well. These two steps can be done in either order.

The power cable connector will be constructed of 1-inch PVC pipe and a 1-inch PVC cross. A 2 meter length of 18-gauge red/black power wire will be attached to the connector. Both a screw hook and a screw eye will act as grab points on the cable connector, but companies may move the power cable connector by any method they wish. The port for the connector will be constructed from 2-inch PVC pipe. The port will be positioned horizontally, i.e., it will be parallel to the bottom of the pool. At the start of the product demonstration, the cable connector will be inserted into the port. Companies must disconnect the power cable from the platform by pulling the connector out of the port. Companies will receive 5 points when the cable connector is no longer touching the 2-inch PVC of the port. Companies may leave the power cable connector anywhere (e.g. on the pool bottom, in a collection basket on the ROV) they wish once it is successfully disconnected.

The valve will be constructed of a ½-inch gate valve and will be built into the ½-PVC framework of the platform. A ½-inch PVC cross will be attached to the gate valve and four 20 cm lengths of PVC will be inserted into the cross. The valve will be positioned vertically (perpendicular to the pool bottom) and located approximately 25 cm above the bottom of the pool. Companies will receive 10 points when they turn the valve to stop the flow of water. Companies must turn the valve clockwise 360^{o}, approximately 1 time around, to successfully stop the flow of water. One 20 cm length of PVC pipe attached to the valve will be painted red to verify the amount of rotation of the valve. No actual water will be running through the valve or pipes.

Companies must then remove the old fountain and install the new fountain. At the start of the product demonstration, the old fountain will be located on the top of the platform, resting over a 1-inch end cap on the corrugated plastic sheet. The new fountain will be located at the surface, side of the pool and can be attached to the vehicle during the set up period. Both fountains will be constructed from a 3-inch to 2-inch ABS reducer bushing with two 1/2-inch end caps attached to the top. A length of rope will serve as a grab point for the fountains. Companies will get 5 points for removing the old fountain. Removing the old fountain is defined as the old fountain no longer in contact with the 1-inch PVC end cap that it rests on. Companies will get 5 points when they install the new fountain. Installing the new fountain is defined as the fountain no longer in contact with the ROV, resting over the 1-inch PVC end cap and flush with the corrugated plastic topside of the platform. The new fountain must be transported by the ROV.

Once the new fountain is installed, companies must reconnect the power cable to the platform and turn the valve to restore the flow of water to the platform. These two steps can be done in either order.

Companies must retrieve the power cable connector, and insert it into the 2-inch PVC port. Companies will receive 10 points when they successfully insert the power cable connector into the port. A successful installation is defined as the 1-inch cross on the cable connector positioned in, or flush against, the 2-inch pipe of the port. The cable connector must stay inside the port until all steps of this task are complete. If this is the final step of the task, the connector must stay inside the port for 5 seconds after being released by the vehicle to count as a successful insertion.

Companies must turn the valve to restore the flow of water to the platform. The valve must be turned counter-clockwise 360^{o}, approximately 1 time around, to restore the flow of water to the platform. Companies will receive 10 points when they successfully turn the valve handle 1 turn counter-clockwise.

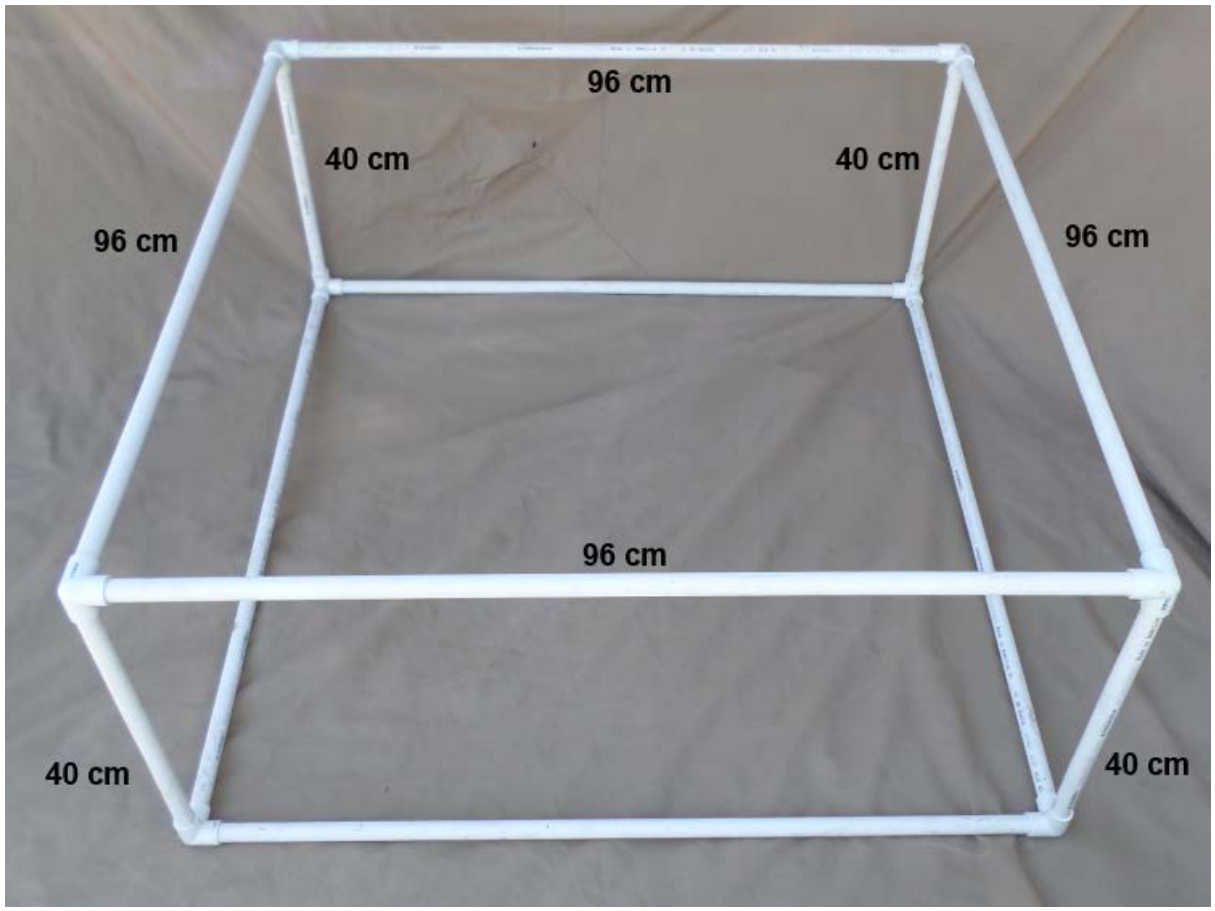
Companies must return the old fountain to the surface, side of the pool. This step may be done at any time after the old fountain is removed from the platform. Companies will receive 5 points when the old fountain is returned to the surface, side of the pool. If returning the old fountain to the surface is the final task of the product demonstration period, time will stop when a member of the company grabs the vehicle at the surface, side of the pool. The old fountain may be removed from the vehicle and placed on the surface, side of the pool after the clock has stopped. If the old fountain is accidentally dropped after the clock has stopped, time will not restart, and the company will not receive a time bonus since all tasks were not successfully completed.

PROP BUILDING INSTRUCTIONS & PHOTOS

Platform

The platform framework will be constructed of ½-inch PVC pipe. A corrugated plastic sheet will cover the top of the platform framework. To construct the platform framework:

1. Cut eight 96 cm lengths of ½-inch PVC pipe. Connect four of these 96 cm lengths of pipe into a square using ½-inch sideouts (corner pieces). Connect the remaining four of these 96 cm lengths of pipe into another square using four more ½-inch sideouts.
2. Cut four 40 cm lengths of ½-inch PVC pipe. These 40 cm lengths of pipe will go between the two squares created with the 96 cm lengths of pipe. Insert the 40 cm lengths of pipe into the remaining openings of the sideouts on each of the 96 cm pipe squares.



NAVIGATOR product demonstration build photo #1: Platform framework.

Power Cable Connector

The cable connector will be constructed from 1-inch PVC pipe. A screw hook and a screw eye act as grab points for the cable connector. Two meters of wire will be attached to the power cable connector. To construct the power cable connector:

1. Cut a 16 cm length of 1-inch PVC pipe. Insert it into one opening of a 1-inch PVC cross.
2. Cut an 8 cm length of 1-inch PVC pipe. Insert it into the opposite opening of a 1-inch PVC cross. Attach a 1-inch end cap to the other end of this 8 cm length of PVC pipe.
3. Drill a 3/16 hole in the center of PVC end cap. Twist a #6 screw eye (Home Depot part # 803682, internet #204273860, Store SKU #727432) into the center hole until all but 1 to 3 mm of threads are inside the plastic of the end cap. The eye should be horizontal, parallel to the side openings of the central PVC cross.
4. Drill a 1/8-inch hole half way between the center of the end cap and the bottom edge of the end cap. Cut a 2 meter length of 18-gauge red/black power wire. Insert one end of this wire into this hole and tie an overhand knot in the wire to secure it inside the end cap. Tie the other end of the 2 meters of wire to a dive or other weight. This weight should be placed approximately 1 meter from the power cable connecter in the power port.

5. Twist a #8 screw hook (Home Depot part #803272, internet #204273853, Store SKU #727320) into the top center of the 1-inch plus. Insert the screw hook until all but 1 to 3 millimeters of thread are visible. Twist the screw hook until the top end faces the back of the cable connector, the 1-inch end cap.

NAVIGATOR product demonstration build photo #2: The cable connector.

Design note: The NAVIGATOR power cable connector is the 2016 ESP cable connector. The 4 meters of rope has been replaced with 2 meters of wire.

Power Port

The port will be constructed from a 20 cm length of 2-inch PVC. This 20 cm length of PVC pipe will be attached to the ½-inch platform framework. To construct the power port:

1. Cut a 20 cm length of 2-inch PVC pipe. Attach a 2-inch coupling to one end of the pipe. Insert a 2-inch to ½-inch reducer bushing (Home Depot model# C437-247, Internet #100343801, Store SKU# 744724) into the coupling.

NAVIGATOR product demonstration build photo #3: The power port.

Attach the port to the bottom corner of the platform, into one of the 96 cm lengths, adjacent to a sideout. To attach the port:

1. Remove one of the 96 cm lengths of pipe on the bottom of the framework. Cut a 3.5 cm length from this 96 cm of pipe. Insert the 3.5 cm length of pipe into the side opening of a ½-inch tee. Insert the remaining 92.5 cm of pipe into the other side opening of the tee. Using a ruler to measure the overall length, cut the 92.5 cm length of pipe down until the entire length is 96 cm. Return this 96 cm length of pipe, now with a tee at one end, into the bottom of the framework.
2. Cut a 3.5 cm length of pipe and insert it into the middle opening of the tee. Rotate the tee so it sticks up at a 45° angle. Attach a 45° elbow to the other end of the 3.5 cm length of pipe.
3. Cut another 3.5 cm length of pipe and insert it into the open end of the 45° elbow. Twist the elbow so the pipe is parallel to the bottom of the pool. Attach the 2-inch to ½-inch reducer bushing (part of the power port) onto the end of the 3.5 cm length of pipe. The power port should be parallel to the bottom of the pool and just above the bottom of the pool.

NAVIGATOR product demonstration build photo #4: The power port attached to the platform.

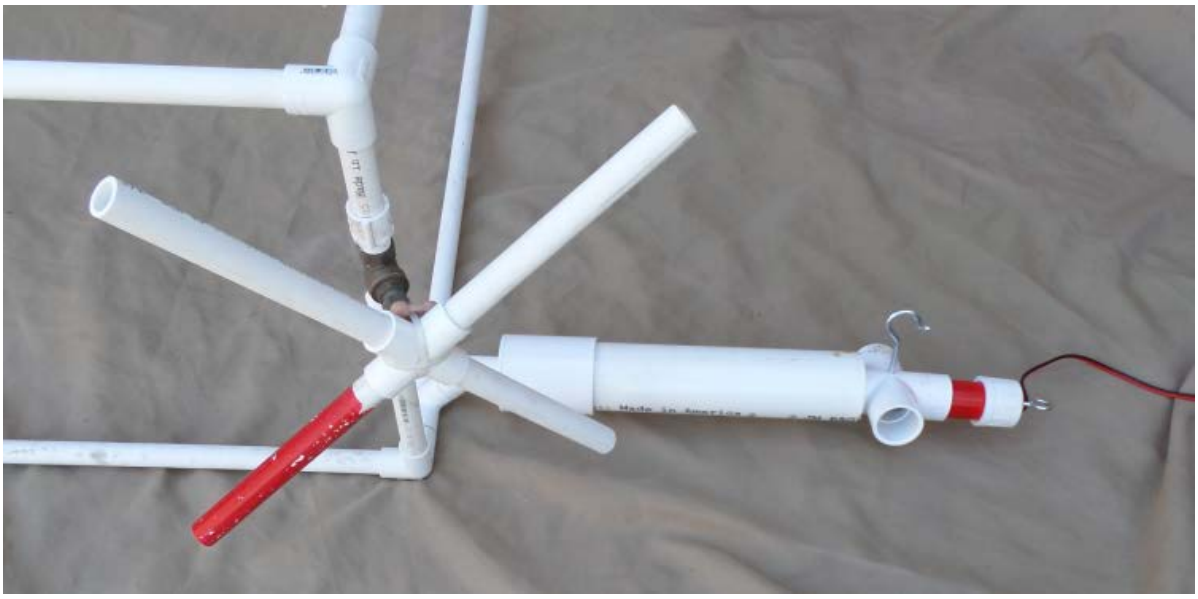
Valve

The valve is located on the same corner of the platform framework. The valve will be constructed from a ½-inch gate valve. A ½-inch cross with 20 cm lengths of pipe serve as a handle to turn the valve. To construct the valve:

1. Attach a ½-inch male adapter into both ends of a ½-inch brass gate valve (Home Depot Model# 170-2-12-EB, Internet# 205816192, Store SKU# 867855). Use zip ties to secure a ½-inch PVC cross onto the valve handle; use 2 or 3 zip ties to secure the cross tightly.
2. Cut four 20 cm lengths of ½-inch PVC pipe. Insert them into the four openings of the PVC cross. Paint one of the 20 cm lengths of pipe red, or other bright color. This will help in determining whether the valve has been turned 360° (1 time around).

3. Remove the vertical, 40 cm length of pipe in the same corner where the power port is attached (see power port, above).
4. Cut 19 cm from the 40 cm length of pipe removed from the framework. Attach one of the male adapters on the end of the gate valve to one end of the 40 cm of pipe. Insert the remaining 21 cm of pipe into the male adapter on the other side of the gate valve. Cut this 21 cm pipe so the total length (19 cm, gate valve, 21 cm pipe) is 40 cm in length.
5. Insert this 40 cm combined pipe back into the sideouts where the 40 cm pipe was removed. The 19 cm length of pipe should go into the sideout on the bottom of the framework. Make sure that the four handles attached to the valve do not hit the bottom of the pool when turning the valve.

NAVIGATOR product demonstration build photo #5: The valve.



NAVIGATOR product demonstration build photo #6: The valve attached to the platform framework with the power cable connector installed.

Corrugated Plastic Sheeting

A 1 square meter sheet of corrugated plastic sheeting goes on top of the platform framework. Use screws to attach this 1 meter square sheet to the top of the framework.

NAVIGATOR product demonstration build photo #7: Corrugated plastic sheet on top of the platform framework.

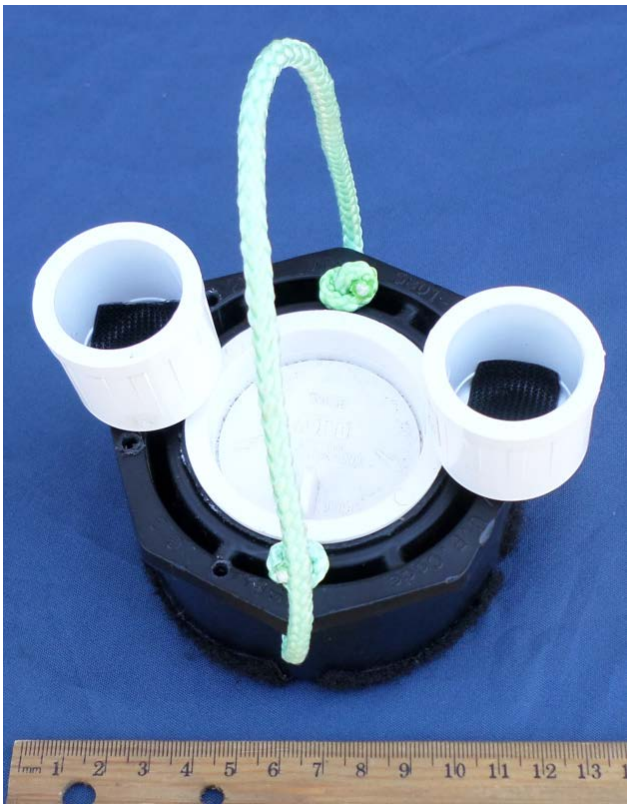
Fountain

The fountain (old and new) will be constructed from an ABS 3-inch to 2-inch reducer bushing (Home Depot model #C58012FHD32, Internet #100343802, store SKU # 188301). It has two ½-inch PVC end caps screwed into the top side. To construct the fountain:

1. Cut a 2 cm length of 2-inch PVC pipe. Insert the 2 cm length of pipe into the 2 cm opening on the reducer bushing.
2. Insert a 2-inch knockout cap (Home Depot model #39101, Internet #100137732, Store SKU #508257) into the 2-inch pipe.
3. Use a screw to secure a ½-inch PVC end cap to the outside of the top edge of the 3-inch to 2-inch ABS reducer bushing. The screw should go straight down into the side wall of the bushing. Repeat this one more time (two end caps total) at opposite sides of the bushing.
4. Cut a 40 cm length of 1/8-inch polypropylene rope (Home Depot part #72402, internet #205804755, Store SKU #402816). Drill two 3/16-inch holes through the top side wall of the wellhead cap on opposite sides. Push the 40 cm length of rope through both 3/16-inch holes. Tie an overhand knot on the ends of each rope to secure the rope to the wellhead cap.

Design note: The fountain for the 2017 task is almost identical to the wellhead cap from the 2016 product demonstration tasks. The 2017 fountains do not require the Velcro add-ons required for the wellhead cap. However, the Velcro does not affect the task in any way and may be included. If you wish to add the Velcro:

1. Cut two 1.8 cm x 1.8 cm squares of Velcro hooks. Adhere the sticky side of the Velcro to the inside bottom surface of the two end caps, over the screw heads holding them in place.
2. Cut four 5 cm x 3 cm lengths of Velcro loops. Attach them around the bottom, angled end of the 3-inch to 2-inch reducer bushing.



NAVIGATOR product demonstration build photo #8: The fountain.

A small piece of flotation can be added to the top of the rope to keep it upright in the water.

A small washer or other weight can be added inside the 2-inch knockout cap to provide additional weight if necessary.

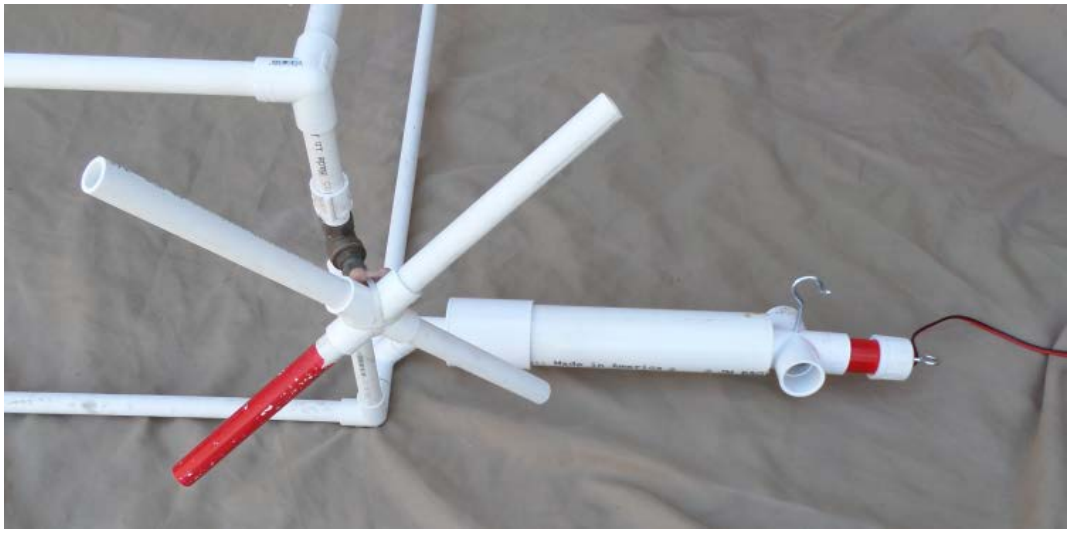
NAVIGATOR product demonstration build photo #9: 1-inch end cap holder for fountain.

RANGER product demonstration build photo #10: The fountain on the platform.

PRODUCT DEMONSTRATION PHOTOS

NAVIGATOR product demonstration photo #1: The power cable connected to the platform.

NAVIGATOR product demonstration photo #2: The power cable disconnected to the platform.



NAVIGATOR product demonstration photo #3: The valve and installed power cable connector.

NAVIGATOR product demonstration photo #4: The completed platform.