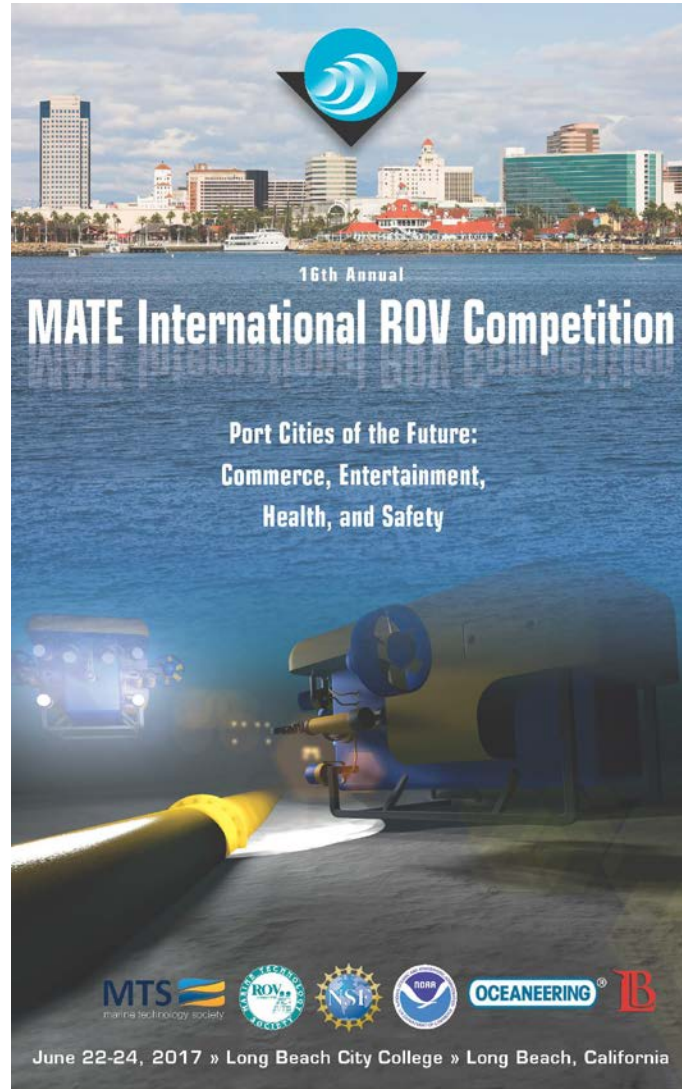


## 2017 MATE ROV COMPETITION: EXPLORER CLASS PREVIEW MISSION



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## **EXPLORER 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 pilot your ROV underneath the platform disengage the locking mechanism at the base of the fountain. Once the lock is disengaged, you must pilot your ROV to the topside of the platform to remove the old fountain and install a new fountain. After installing a new fountain, you must pilot your ROV under the platform to re-engage the locking mechanism. Then 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**
- **Disengaging the locking mechanism at the base of the fountain – 5 points**
- **Removing the old fountain – 5 points**
- **Installing the new fountain – 5 points**
- **Re-engaging the locking mechanism at the base of the 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 = 60**

#### **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 then disengage the locking mechanism at the base of the fountain, remove the old fountain, install the new fountain, and re-engage the locking mechanism at the base of the fountain. These four steps must be done in order. After the base of the new fountain has been locked in place,

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 and one side. The framework will rest on the bottom of the pool. The platform will be approximately 2 meters long, 1.15 meters wide and 1 meter tall. ROVs will have to work around, above, and inside the platform framework.

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 ½-inch PVC pipe and a 1 ½-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. The valve will be positioned vertically (perpendicular to the pool bottom) and located approximately 45 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 1080°, approximately 3 times around, to successfully stop the flow of water. A black mark on the valve handle will verify the number of rotations of the valve. No actual water will be running through the valve or pipes.

To access the locking mechanism, companies will have to maneuver underneath and inside the structure of the platform framework. Once inside the platform framework, companies must disengage the locking mechanism at the base of the fountain. The locking mechanism will be constructed of a 1-inch PVC cross and ½-inch PVC pipe. To disengage the locking mechanism, companies must turn the ½-inch PVC handle 180°. Companies will receive 5 points for unlocking the base of the fountain.

Companies must then exit the platform framework, 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 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 5-minute set up period. Both fountains will be

constructed from a 3-inch to 2-inch ABS reducer bushing with four 1/2-inch end caps attached to the top. The old fountain will be positioned over a 1-inch end cap screwed into the topside of the corrugated plastic. Companies will receive 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 receive 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 maneuver underneath and inside the structure of the platform framework and re-engage the locking mechanism at the base of the fountain. To re-engage the locking mechanism, companies must turn the ½-inch PVC handle 180° back to its original, locked position. Companies will receive 5 points when they successfully re-engage the locking mechanism at the base of the fountain.

After re-engaging the locking mechanism, 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 ½-inch cross on the cable connector positioned 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 1080°, approximately 3 times around, to restore the flow of water to the platform. Companies will receive 10 points when they successfully turn the valve handle back to the fully on position. One 20 cm length of PVC pipe attached to the valve will be painted red to verify the number of rotations of the valve.

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.

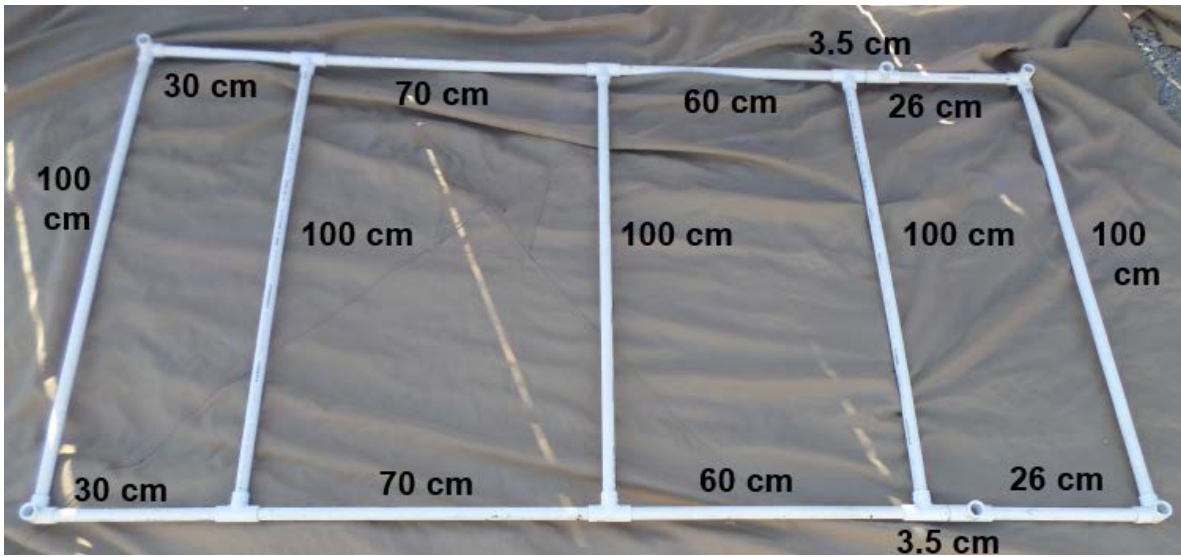
## PROP BUILDING INSTRUCTIONS & PHOTOS

### Platform

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

1. Cut five 100 cm lengths, two 70 cm lengths, two 60 cm lengths, two 30 cm lengths, two 26 cm lengths, and two 3.5 cm lengths of ½-inch PVC pipe.
2. Take a 30 cm length and attach the side opening of a PVC tee to one end. Insert a 70 cm length of PVC pipe into the other side opening of the PVC tee. Attach the side opening of another PVC tee to the other end of the 70 cm length of pipe. Insert a 60 cm length of pipe into the other side opening of the PVC tee. Attach the side opening of another PVC tee to the other end of the 60 cm length of pipe. Insert a 3.5 cm length of pipe into the other side opening of the PVC tee. Attach the side opening of another PVC tee to the other end of the 3.5 cm length of pipe. Turn this tee perpendicular to the other tees. Insert a 26 cm length of pipe into the other side opening of the PVC tee.
3. Attach a ½-inch sideout (3-way) to the 30 cm pipe on one end of the combined segments of pipe. Attach a different ½-inch sideout to the 26 cm pipe on the other end of the combined segments of pipe.
4. Repeat steps two and three, making a second combined section of pipe. The sections should contain: a sideout, 30 cm pipe, tee, 70 cm pipe, tee, 60 cm pipe, tee, 3.5 cm pipe, tee, 26 cm pipe, sideout.
5. Use the five 100 cm lengths of pipe to connect the combined sections of pipe. Two of the 100 cm lengths go into the two sideouts on either end. The other three 100 cm lengths go into the tees between the 30 cm length and the 70 cm length, the tee between 70 cm length and 60 cm length, and the tee between the 60 cm length and the 3.5 cm length.

This will make one sidewall of the platform.



**EXPLORER product demonstration build photo #1: Sidewall of the platform.**

6. Repeat steps 1 through 5 to make a second sidewall of the platform.
7. Cut four 115 cm lengths and four 56 cm lengths of ½-inch PVC pipe.
8. Line up the two sidewalls of the platform so the 70 cm lengths and 60 cm lengths are across from each other (symmetrical). Use the four 115 cm lengths of pipe to join the two sidewalls at the corners, inserting the 115 cm lengths of pipe into the sideouts at each corner.
9. Insert two 56 cm lengths of pipe into the side openings of a ½-inch PVC tee. This should make a combined length of approximately 115 cm. Repeat this with the other two 56 cm lengths of pipe and a second tee.
10. Insert these combined 115 cm lengths of pipe into the remaining middle openings of the tees. These tees should be located between the 3.5 cm and the 26 cm length of PVC pipe.



**EXPLORER product demonstration build photo #2: Framework of the platform.**

**Locking Mechanism:**

The locking mechanism is located inside the platform framework. The locking mechanism will be constructed from a 1-inch PVC cross that rests on ½-inch PVC. The locking mechanism is located halfway up a vertical PVC pipe inside the platform framework.

1. Cut a 55 cm length, a 35 cm length, a 12 cm length, two 5.5 cm lengths, and four 2.5 cm lengths of PVC pipe.
2. Insert the 35 cm length of pipe into the middle opening of the tee (56 cm length, tee, 56 cm length) on the bottom crosspiece of the framework. Attach a PVC cross to the topside other end of the 35 cm length of pipe. Insert a 3.5 cm length of PVC pipe into the opening of the cross opposite of the 35 cm length. Attach a ½-inch PVC coupling to the other end of the 3.5 cm length of pipe. Insert another 3.5 cm length of pipe into the other end of the coupling. Attach another coupling to the other end of this 3.5 cm pipe.
3. Insert the remaining two 3.5 cm lengths of pipe into the two remaining side openings of the ½-inch cross. Attach a 90° elbow to the other end of each 3.5 cm length of pipe. Insert the two 5.5 cm lengths of pipe into the open ends of the two 90° elbows.
4. Twist the cross so it is perpendicular to the sidewalls of the framework, parallel to the closest back wall of the platform framework. Twist the two 90° elbows so they angle about 20 degrees back towards the back wall of the platform framework (see photo #3).



**EXPLORER product demonstration build photo #3: Locking mechanism internal, front and side view.**

5. Install a 1-inch PVC cross over the two ½-inch couplings. It should fit over the couplings with the bottom opening resting against the ½-inch tee. Insert a 1-inch to ½-inch reducer bushing into a side opening of the 1-inch PVC cross. Insert the 12 cm length of ½-inch pipe into the reducer bushing.

The 1-inch PVC cross should rotate 180° around the ½-inch couplings. The 5.5 cm lengths of pipe attached to the 90° elbows act as backstops to the rotation. Adjust the angle of the two 90° elbows as needed to create the stopping point for the 12 cm pipe at opposite ends of the 180° rotation.

6. Insert the 55 cm length of pipe into the open end of the ½-inch coupling. The top end of this 55 cm length of pipe should fit into the middle opening of the tee at the top of the platform framework.





**EXPLORER product demonstration build photo #4: Locking mechanism; locked and unlocked.**

### **Corrugated Plastic Sheeting**

The framework should be approximately 2 meters long, 1.2 meters wide, and 1 meter tall. Cut a 2 meter by 1.2 meter rectangle of corrugated plastic sheeting. Use screws to attach this sheeting onto the top side of the platform framework. Cut a 1.2 meter by 1 meter rectangle of corrugated plastic sheeting. Use screws to attach this sheeting onto the back wall of the platform, the side closest to the locking mechanism.



**EXPLORER product demonstration build photo #5: Platform.**

Use screws to hold the platform framework together and to secure the corrugated plastic to the frame.

### Power Cable Connector

The cable connector will be constructed from 1 ½-inch PVC pipe. A screw hook and a screw eye act as grab points for the cable connector. Two meters of 18-gauge red/black wire will be attached to the power cable connector. To construct the power cable connector:

1. Cut a 16 cm length of 1 ½-inch PVC pipe. Insert it into one opening of a 1 ½-inch PVC cross.
2. Cut an 8 cm length of 1 ½-inch PVC pipe. Insert it into the opposite opening of a 1 ½-inch PVC cross. Attach a 1 ½-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 connector 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 ½-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 ½-inch end cap.



**EXPLORER product demonstration build photo #6: The power cable connector.**

Design note: The EXPLORER power cable connector is the 2016 ESP cable connector. The 8 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.



**EXPLORER product demonstration build photo #7: The power port.**

Attach the port to the bottom corner of the platform, into the 30 cm length of PVC pipe. To attach the port:

1. Remove the 30 cm length of pipe on the bottom corner of the framework. Cut a 3.5 cm length from this 30 cm of pipe. Insert the 3.5 cm length of pipe into the side opening of a ½-inch tee. Insert the remaining 26.5 cm of pipe into the other side opening of the tee. Use a ruler to measure the overall length. Cut the 26.5 cm pipe down until the entire length is 30 cm. Return this 30 cm length of pipe, now with a tee at one end, into the bottom corner of the framework. The tee should be adjacent to the sideout at the corner.
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.



**EXPLORER product demonstration build photo #8: The power port attached to the platform.**

### **Valve**

The valve is located on the same corner of the platform framework as the port. The valve will be constructed from a ½-inch gate 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).
2. Remove the vertical, 100 cm length of pipe in the same corner where the power port is attached (see power port, above).
3. Cut 40 cm from the 100 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 60 cm of pipe into the male adapter on the other side of the gate valve. Cut this 60 cm pipe so the total length (40 cm, gate valve, 60 cm pipe) is 100 cm.
4. Insert this 100 cm combined pipe back into the sideouts where the 100 cm pipe was removed. The 40 cm length of pipe can go either on the top end or bottom end of the 100 cm length. Rotate the valve so the handle (PVC cross) is outside of the platform.



**EXPLORER product demonstration build photo #9: The valve.**



**EXPLORER product demonstration build photo #10: The valve attached to the 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 four 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 three more times (four end caps total) at equal distances around the bushing.

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 four 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 four 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.



**EXPLORER product demonstration build photo #11: The fountain.**



**EXPLORER product demonstration build photo #12: 1-inch end cap holder for fountain.**



**EXPLORER product demonstration build photo #13: The fountain on the platform.**

## PRODUCT DEMONSTRATION PHOTOS



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



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





**EXPLORER product demonstration photo #3: The platform.**