

OIL SPILL RESPONSE/ROV BUILD ACTIVITY TEACHER INSTRUCTIONS

See lesson plan for all activity materials.

ROV Build

Before activity:

- Determine number of groups in class (groups of 3-5 students).
- Print 1 copy of “ROV Design and Oil Spill Response” worksheet for each student.
- Print 1 copy each of “ROV Frame Examples” and “Points to Ponder” for each group.
- Charge batteries.
- Assemble ROV build materials in totes for transportation.
- Reserve pool or arrange space with Harbormaster.

Procedure (3 hours):

1. Handout “ROV Design and Oil Spill Response” worksheet to each student.
2. Give “ROV Design and Oil Spill Response” presentation to class. (35 min)
 - a. What is an ROV?
 - b. Work through worksheet questions.
 - c. Review Arctic setting.
 - d. Review oil spill response challenge.
 - e. Review frame designs and parts for use.
 - f. Review “Points to Ponder.”
3. Divide class into groups/companies. Hand out “ROV Frame Examples” and “Points to Ponder” to each group. (5 min)
4. Tell each group they will be a company and have to come up with their name and an ROV design. Companies will then design their ROVs. Companies must have their design approved before starting to build. The ROV design may be modified or changed later, but students should have some direction when beginning. Frame design must meet challenge tasks. Students should have access to PVC as they design their ROV. (20 min)
5. Once companies are finished with their designs they can start to build their ROV frames using PVC piping and motor sets. (120 min)
 - a. Teams must inspect the motor rotation and decide on a configuration for motors.
 - b. After initial frames have been built, instructors will demonstrate to each group how to attach the motors.
 - c. Instructors guide students towards the correct placement for each motor in order to achieve the desired configuration; students secure the motors to their frame.
 - d. Students attach netting if desired.
 - e. Students attach foam for buoyancy.

Instructors have a score sheet for each team. They should rotate among the groups looking for teamwork. Keep the “Points to Ponder” in mind. When some progress has been made, ask each group how their ROV will accomplish the required tasks. Make sure the frame size is within limits. While students are completing their ROV frames, instructors should make sure each frame and motors are tightened so nothing falls off in the water.

Water Challenge

Before activity:

Set up stations for each group to work through (see diagram below). Each station will consist of:

- 1 hula hoop submerged vertical in pool at depth
- 1 medium sized weighted ring submerged vertical in pool at depth
- 1 hula hoop horizontal floating on surface
- 1 1’x1’ square vertical in pool at depth
- 1 ring hook/weighted bucket
- 1 beach ball
- Popcorn/ping pong balls
- 1 “human seal” who is in water and can retrieve/reset challenge materials, untangle ROVs, etc.

Procedure (2 hours):

1. Orientation: Review water safety procedures, keeping batteries and control boxes away from water, tether manager, no swimming, use of “seal” to retrieve/reset course, review point breakdown. (5 min)
2. Float test: Student teams bring their ROV to water’s edge and conduct a float test: does the ROV sink or float? Can it drive straight? Do ballast, floatation, or motor placement need to be adjusted? (30-45 min)
3. Challenge: Student teams attempt water challenge activities. Students should take turns driving, at least 2 minutes each or complete one challenge activity (teams are given points based on working as a team). Teams may use the “seal” to reset their obstacle course (retrieve floating beach ball, reset hooks and rings). Teams may use the “seal” to untangle their ROVs from one another. (50-75 min)
4. Breakdown and pack: Student teams disassemble their ROVs and return all materials to kit. Students clean up all foam, zip ties, tape and other trash before leaving. (10 min)
5. Wrap-up (10 min)
 - Review essential properties of water that affect ROVs (pressure, density, buoyancy).
 - Review which challenges were difficult or easy to complete.
 - Review concepts of aquatic oil spills and how we can use technology to respond.

Assessment: Assess student progress throughout the ROV building sessions and use score sheet. Give prompts and suggestions if students are spending too much time on one stage. Keep an eye on group dynamics and make sure all students are involved in their team's design. Make sure students aren't distracted or sidetracked by the PVC pieces and connectors.

- Task 1: Perform a scouting mission to search for pools of oil trapped under the ice
5 points
Simulated by driving the ROV back and forth to a small stationary underwater ring

- Task 2: Take a sample from a pool of oil in the ice
5 points
Simulated by surfacing the ROV inside a large floating ring and holding position for 5 seconds

- Task 3: Return sample and have it analyzed
10 points
Simulated by positioning the ROV in front of a stationary underwater square and holding position for 5 seconds

- Task 4: Deliver a piece of equipment inside an underwater work station
20 points
Simulated by flying ROV through a large stationary underwater ring (5 points), picking up an underwater small ring (5 points) and depositing small ring on a PVC arm (10 points)

- Task 5: Transport floating equipment
10 points
Simulated by throwing a beach ball out onto water's surface and returning it using the ROV

- Task 6: Respond to an open water surface oil patch in a polyana
25 points
Simulated by gathering and removing floating popcorn/ping-pong balls from the water's surface

