Build an Underwater Robot

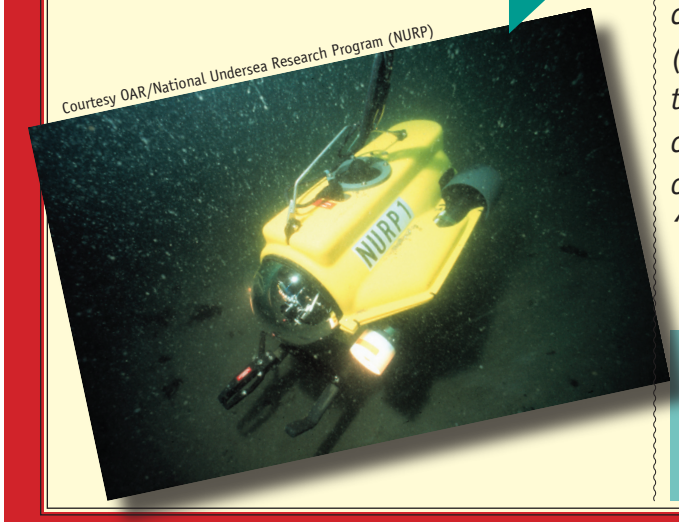
What can swim deep inside the wreck of the Titanic?

What can sit on the edge of an erupting underwater volcano?

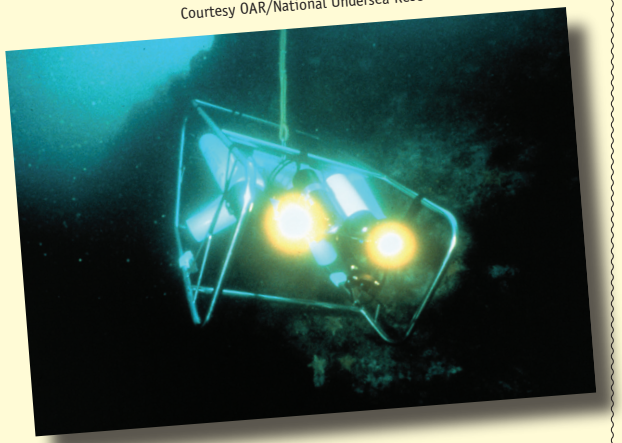
What can dive thousands of feet below the ocean surface?

What can collect animals no one has seen before from the deep ocean?

Underwater robots can!



Courtesy OAR/National Undersea Research Program (NURP)



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Some underwater robots are controlled by built-in computers, and can operate without any connection to the surface. These are called "Autononomous Underwater Vehicles" (AUVs). Many underwater robots are attached to a cable that allows a human operator to control the robot's movements from a ship on the ocean surface. These robots are called "Remotely Operated Vehicles" (ROVs).

What You Will Need

- ❒ Plastic coat hanger
- ❒ 6- or 12-volt DC motor (from a hobby shop; part number LXJSS4 from www.towerhobbies.com is a 6-volt motor; part number 273-256 from Radio Shack is a 9–18-volt motor)
- ❒ Model boat propeller (from a hobby shop, or visit www.towerhobbies.com and search on "boat propeller")
- ❒ Epoxy glue
- ❒ Two pieces of #28 AWG stranded wire (telephone wire), each about five feet long
- ❒ Electrical tape
- ❒ Two film canisters with lids
- ❒ Twelve nails, about three inches long or 1/4-inch diameter bolts to use as weights
- ❒ One or two 6-volt batteries (two if you are using a 12-volt motor)
- ❒ Container of water at least 18 inches deep (bathtub, large laundry tub, etc)
- ❒ Hot glue gun
- ❒ Wire cutters or wire stripper or a sharp knife
- ❒ Optional: Hand drill and drill bit of same diameter as the motor shaft

What You Will Do

Make a simple version of an underwater remotely operated vehicle

Warnings

1. Do not connect a wire directly between the two terminals of a battery. The wire will rapidly become very hot and may start a fire or cause serious burns!
2. Do not do this activity in saltwater because everything will short out and your motor will be ruined.
3. If you use a knife to remove insulation from the wires, be careful! Put the wire onto a cutting board and roll the knife over the wire to cut the insulation, but not the wire. Keep your fingers clear of the blade!

How to Do It

1. Press the propeller onto the shaft of the motor. If the propeller is loose on the shaft, place a small drop of epoxy glue on the end of the shaft before installing the propeller. If the shaft is too large for the hole in the propeller, enlarge the hole slightly with a hand drill fitted with a small drill bit. (You may need help from an adult for this.)

2. Hold the coat hanger so that the hook is pointed down. Tape the motor onto the inside of the hook so that the propeller is facing up.

3. Tape the two film canisters, with lids on, to the upper part of the coat hanger.

4. Tape enough weights to the lower parts of the coat hanger (near the hook) so that the coat hanger floats just below the surface of the water.

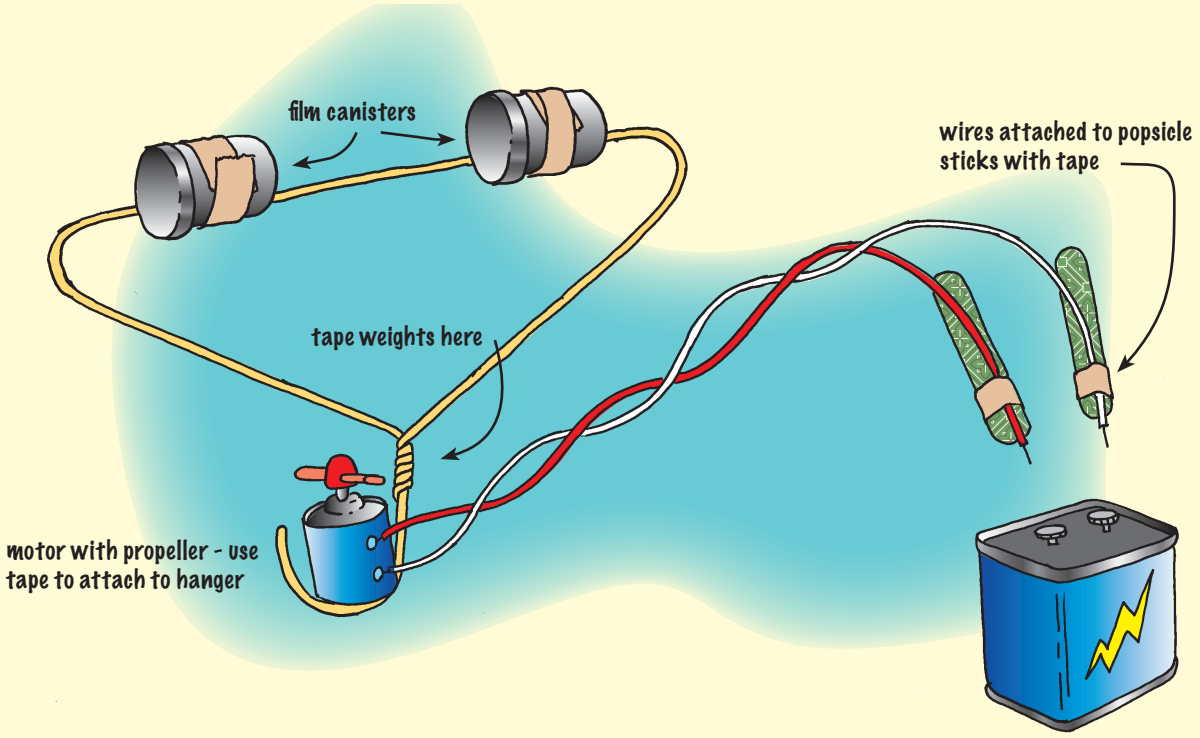
5. Strip about one inch of insulation off of both ends of each wire.

6. Twist one end of each wire onto a terminal of the motor. If necessary, you can keep the wires in place with a dab of hot glue.

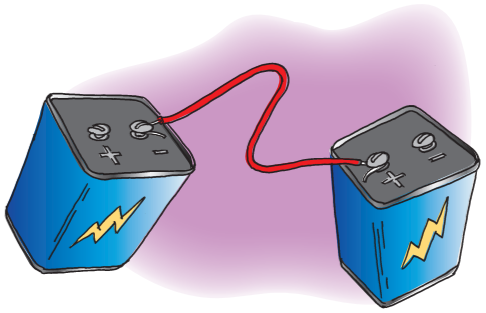
7. Twist the wires together to make a single cable.

8. Tape the other end of each wire to a popsicle stick or chopstick so that the bare wire end is hanging over the end of the stick.

9. If you are using a 12-volt motor, connect two 6-volt batteries in series: Strip about one inch of insulation off of both ends of a piece of #28 AWG wire about 12 inches long. Twist one end of the wire around the negative terminal of one battery, and twist the other end of the wire around the positive terminal of the other battery.



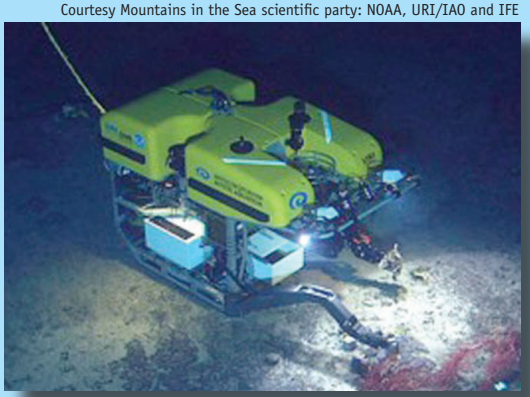
10. Test Dive Your ROV: Touch the bare end of one wire to one battery terminal, and the bare end of the other wire to the other battery terminal. If the propeller spins but does not sink, try reversing the wires on the battery terminals. If your ROV still doesn't sink, you may need to add some more weight.



Adapted from an activity by Harry Bohm and the Marine Advanced Technology Education Center (MATE). www.marinetech.org

A Little More About Underwater Robots

Courtesy Mountains in the Sea scientific party: NOAA, URI/IAO and IFE



Ocean explorers use ROVs for many purposes, including monitoring underwater habitats, observing fishes and other organisms, exploring deepsea environments, investigating shipwrecks, and studying areas too dangerous for humans such as active underwater volcanoes. Underwater robots are essential tools of modern ocean explorers.

ROVs may be large or quite small, depending upon the jobs they are expected to do, but they all have some systems in common:

- Framework on which other components are mounted;
- Flotation so that the ROV is neutrally buoyant (or nearly neutral; this means it doesn't rise or sink when in the water);
- Ballast to keep the robot from rolling over;
- Power to operate motors, video cameras, and other equipment;
- Propulsion to move the robot up and down, side to side, and backward and forward;
- Control to cause the robot to perform certain tasks; and
- Navigation to keep track of the robot.

Some of these systems may not actually be on the ROV itself, but instead may be on a ship and connected to the ROV with a cable. Most ROVs carry video equipment, and many have manipulator arms that can collect samples, handle tools, etc.

For more information about underwater robots and ocean exploration, visit *http://oceanexplorer.noaa.gov/technology/subs/subs.html*. Scroll down the page for links to all kinds of submersibles!

Want to Do More?

1. Add two more motors to your ROV to make it move horizontally. You should be able to make your ROV spin or move in a straight line, depending upon how you connect the motors and the battery.

2. For more underwater robots you can build, check out these books by Harry Bohm:
   Bohm, H. 1997. *Build your own underwater robot and other wet projects.* Westcoast Words. 148 pages.

   Bohm, H. and V. Jensen. 1998. *Build Your Own Programmable Lego Submersible: Project: Sea Angel AUV (Autonomous Underwater Vehicle).* Westcoast Words. 39 pages.