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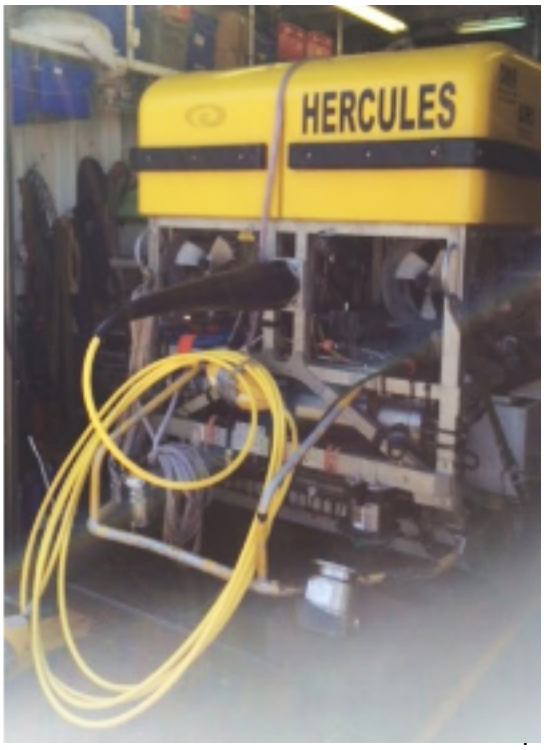
Build A Conductivity Tester

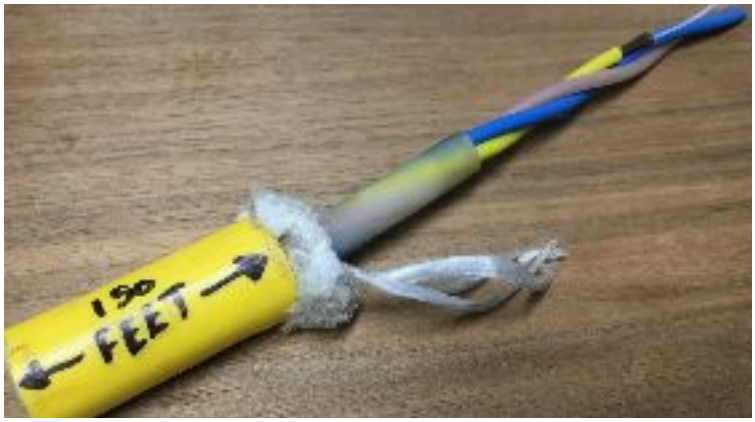
THE BASICS

Some materials do an excellent job of conducting electricity through them, while others do not. Materials that allow the electrons to flow easily through them due to their atomic makeup are called conductors. Materials that do not easily allow electrons to flow through them are called insulators. The following chart shows some common conductors and insulators.

Conductors	Insulators
Copper	Rubber
Water	Glass
Animals such as humans!	Porcelain

Since water is an excellent conductor, engineers have to design and use specialized insulative coatings to protect electronic equipment from short-circuiting while working underwater. The yellow tether cable seen below attaches Remotely Operated Vehicle (ROV) *Hercules* to ROV *Argus.* The cable not only keeps *Hercules* attached to the ship but also insulates the fiber optic wires that provide power from generators on the ship to all the systems on the robot. Since salt makes water more highly conductive, engineers have to take extra care in designing tether cables to work in marine environments.





Examine the dissected section of tether which connects ROV *Hercules* and ROV *Argus* bringing connectivity and power to the seafloor. Within the yellow casing is a white insulation layer wrapping a core with three twisted copper conductors and three fiber optic glass strands within their own insulated wrapping. Wires carry high voltage electricity from the ship to the ROVs powering lights, cameras, and instruments. The fiber optic strands are thin glass pieces which move information in the form of light pulses transmitting data and video imagery seen on *www.nautiluslive.org*.

GOALS

- Use household supplies (see materials list below) to create a tool to test conductivity of different materials.
- Explore how electrically conductive or insulative different materials are using your tester.

SAFETY WARNING!!

You are using low voltage batteries and components for this lesson. NEVER connect a conductive material between the (+) and (-) ends of a battery. The material will get hot and could potentially burn you and the battery will quickly lose its energy, creating a short circuit.

NEVER experiment with wall outlets. These are operating at much higher voltages and pose a safety hazard or even death if not used correctly.

MATERIALS

- Aluminum foil
- Masking or electrical tape
- Batteries (9v or 1.5v)
- Small flashlight bulbs (1.5v or 4.5v)
- 1 piece of cardboard
- 1 wooden clothespin

PROCEDURE

1. Choose the appropriate number of batteries for the circuit by comparing battery voltage to that of the bulbs used. In the example shown, two D-cell batteries were connected to power one 4.5v light bulb.
2. Make your “wires” by folding aluminum foil strips neatly into thin rectangular strips.
3. Use a piece of cardboard and masking tape to secure your components together to make a circuit, leaving two ends of aluminum foil wires loose.
4. Connect the batteries in a circuit: attach one “wire” to the positive (+) end firmly with masking or electrical tape and the other “wire” securely to the negative (-) end.
5. Connect the bulb to the circuit: firmly attach one “wire” to the side of the base of the bulb, attach the other “wire” directly to the raised contact on the bottom. Use tape and a clothespin to secure connections to the bulb.
6. Check if the circuit is working: touch the two ends of the foil “wires” together. If working correctly, the bulb will light. If not, double-check the connections around the circuit to make sure everything is secure. If two or more batteries are connected, make sure the connection between them is tight enough.

Example Conductivity Tester:

How to Test a Material's Conductivity:

Place the object between the two open ends of the aluminum "wires". If the material is a conductor, electrons will flow through the object, complete the circuit and the light will turn on. If the material is an insulator, electrons won't pass easily through the particles within the object interrupting the flow, and the lightbulb will remain off.

7. Complete the chart below recording each material tested. First, make a hypothesis whether each material will be able to conduct electricity. For each material tested check whether it is insulative or conductive. Learn more about conductivity here: http://www.physicsclassroom.com/class/estatics/Lesson-1/Conductors-and-Insulators

Material	Hypothesis? Conductor (C) or Insulator (I)	Insulator	Conductor

REFLECTION QUESTIONS

1. If you rearrange the same materials in a circuit, does the arrangement impact whether or not the circuit works?

2. What similarities do you observe between materials that are conductors? What similarities do you observe between materials that are insulators?

3. The battery and light bulb were not touching. How do you know electricity flowed between them? Give an example as evidence.