

Digital Multimeters

Overview: Today you're going to learn how to use one of the most important tools that scientists use. You'll get to "see" electricity as you test them. And you'll never have to wonder if a battery is good or bad again.

What to Learn: Although these are the most common electrical testers, there's more than one device in that box. It measures volts, amps (current), and resistance (how easy it is for electricity to get through a wire). We're going to learn how to use it in a useful, practical way to measure volts and detect problems with non-working circuits.

Materials

- Digital Multimeter (DMM)
- Circuit equipment from Experiments 10-12 for testing

Lab Time

1. Plug your probes into the DMM. The black lead goes to ground. Push it in all the way.
2. Put the red lead in the hole that says "V" for volts. It usually has the " Ω " symbol (pronounced "omega") which stands for ohms, or it might say "ohms," or even "mA" for milli-amps. Don't put it in the hole that says "10A" – that's for testing large currents like in your house.
3. Turn the dial. Feel how it clicks?
4. You can test two different kinds of voltage: DC and AC. AC is the kind inside your house wiring. We're going to test DC with our circuit. Set your arrow on the meter to the DC voltage, which is the V with a straight line on top of it (the V with a squiggling line is AC volts). Set the knob in the DC volt area to the mark that says "20."
5. Take an AA battery and touch one probe end to the plus, and the other probe to the minus. You should get a reading. What did you get for a reading on your DMM? (Remember to write V after the number for "volts".)

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6. Test your second battery and write the reading here:
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If the battery is good, it should read between 1.4 – 1.6 volts, depending on how fresh they are. Brand new batteries give a higher reading. Generally, if AA, AAA, C, or D cell batteries read 1.3 volts or higher, they are good and will work in your circuit. If they read between 1 – 1.3 volts, they may or may not work, depending on the type of circuit you're using them in. Anything less than 1 volt won't work and should be disposed of. 9V batteries are good between 7-9 volts.

7. Insert your batteries into the battery case. Touch the probe test leads to the ends of the wires from the battery case. What do you read?

8. Wire up a circuit that uses a battery pack and a motor.
9. Using your probes, touch a test probe to each terminal of the motor and read how many volts you have at the motor. The motor is using a bunch of volts, so it's going to vary. So here's how you read how many volts the motor is really getting: disconnect the alligator clip wires from the back of the motor (so the motor no longer in the circuit) and attach them instead to just the probes. What do you read?

10. Discuss with the students about how to differentiate observation from inference (interpretation). Scientists' explanations come partly from what they observe and partly from how they interpret their observations. After they take their data, ask them if they notice any patterns in their data.

Taking turns, have one lab partner wire up *one part* of a circuit incorrectly, like putting two alligator clip wires on one LED lead, putting a battery in backward, etc. Keep it simple, but the circuit shouldn't work at first. Use the DMM to figure out where the problem is. Now fill out the data table:

DMM Data Table

[illegible]

Reading

A DMM (Digital Multi-Meter) or DVOM (Digital Voltage Ohm Meter) is a handheld device that scientists pull out when things go wrong. This handy tool can detect problems with electronics, motor controls, appliances, power supplies, and circuits in no time.

It's not enough to know how to use the buttons and dial. You also have to know *how* to test your circuit. That's what we're going to do with this lab.

If you like history, the first device to detect current was a galvanometer (we're making one of these later on) way back in 1820. It wasn't until the 1920s when vacuum-tube electronics were common that the first multimeter was invented by an upset engineer who was frustrated that he had to carry around so many different devices to do his job maintaining telecommunication circuits with the British Post Office.

Exercises

1. If you measure 2.65 volts from your battery pack, do you need new batteries or will they work?
2. How do you think you would measure the resistance of an LED?
3. Reset your meter for a quick practical test: Remove the wires from your DMM and set the dial at OFF. Wave your hand wildly and show how you can use the meter (you can add probes and turn it on now) to test the voltage on your LED in a simple circuit doing the steps from the experiment.

Answers to Exercises: Digital Multimeters

1. If you measure 2.65 volts from your battery pack, do you need new batteries or will they work? (You have to test each battery individually to see if they are both above 1.3 volts.)
2. How do you think you would measure the resistance of an LED? (Turn the dial to the " Ω " mark to measure ohms and put each of the probes on one of the LED's wires and read the value.)
3. Reset your meter for a quick practical test: Remove the wires from your DMM and set the dial at OFF. Wave your hand wildly and show your teacher how you can use the meter (you can add probes and turn it on now) to test the voltage on your LED in a simple circuit doing the steps from the experiment.