ScienceCube

Measuring Battery Voltage

Learning Objectives We can observe the batteries we use around us and measure their voltage.

Should I think about it? What difference might there be between the voltage printed on the surface of a new battery and the actual measured voltage?

Learning Content

1. What is a Battery?

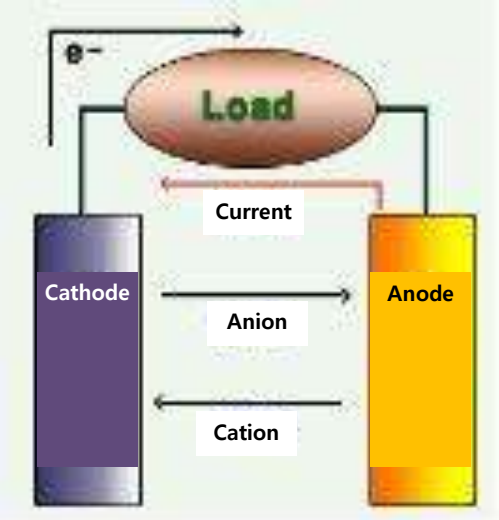
- A battery is a device that converts chemical energy into electrical energy through the decomposition of materials within it. The term "battery" generally refers to a chemical cell, which is a device that converts energy generated by chemical or physical reactions of materials into electrical energy. Batteries are used in wristwatches, hearing aids, shavers, calculators, etc., and they can be used anywhere without being restricted by location. However, they need to be replaced when their lifespan is over.

- There are primary batteries and secondary batteries. Primary batteries are those that cannot be reused once they are depleted. In contrast, secondary batteries, such as lead-acid batteries used in cars and NiCad batteries used in cassette players, can be recharged and used again. Currently, the demand for high-capacity secondary batteries is increasing, while the use of primary batteries is gradually decreasing.

2. Basic Principle of Batteries

Electrons released from the oxidation reaction at the anode travel through the external circuit to the cathode. These electrons are then transferred to ions that have reached the cathode from the anode, resulting in a reduction reaction.

Electrons flow from the anode to the cathode, and ions move with cations traveling to the cathode and anions traveling to the anode, forming a closed circuit overall.



3. Types of Batteries

Relative size comparison								
Notation standard	USA	CR123A	AAA	AA	C	D	FC-1	4FM
	International	-	R03	R06	R14	R20	6F22	4R25
	Japan	-	UM4	UM3	UM2	UM1	006P	4R25
Size (diameter x height)mm		17x34.5	10.5x44.5	14.5x50.5	26.2x50	34.2x61.5	26.5x17.5x48.5	67x67x115
Voltage(V)		3V	1.5V				9V	6V

The official voltage of an AA battery is 1.5V. The voltage of nickel-cadmium batteries and rechargeable batteries is 1.2V. Some batteries using special chemicals can deliver up to 1.6V under load.

The voltage values of AA, AAA, C, and D batteries are all 1.5V. However, AA batteries are larger than AAA batteries, meaning they contain more chemicals needed for power generation and can be used for a longer time.

Experimental Activities

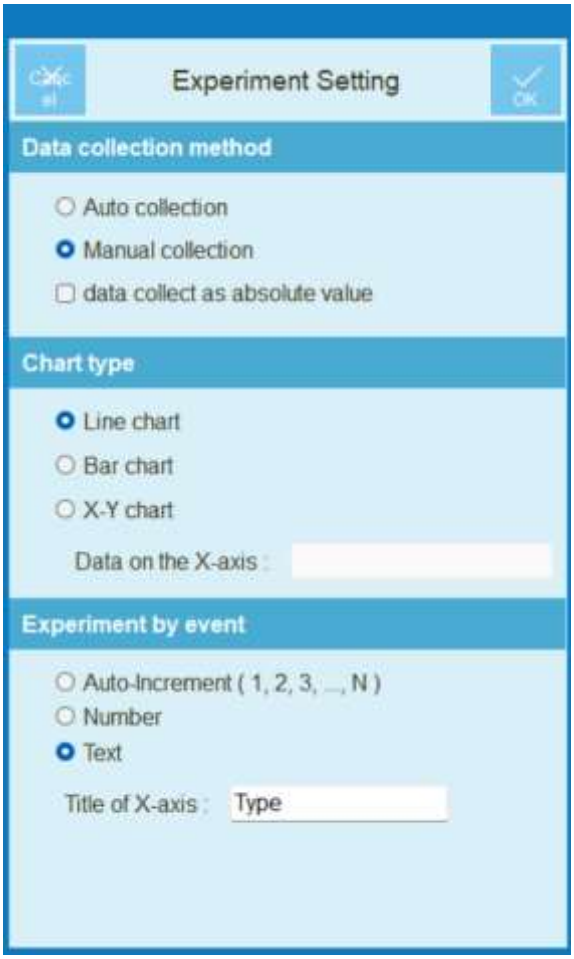
Materials

Interface, Science# program (smart device), voltage sensor, batteries (AAA, AA, D, FC-1), used batteries, nichrome wire

Experiment Procedure

Preparing the Equipment

1. Run the Science# program on the smart device and connect it to the powered interface via Bluetooth or cable.
2. Connect the voltage sensor to the interface..
3. Press the setup button  in Science# to configure the experimental environment as shown below (the button will automatically set up the configuration).



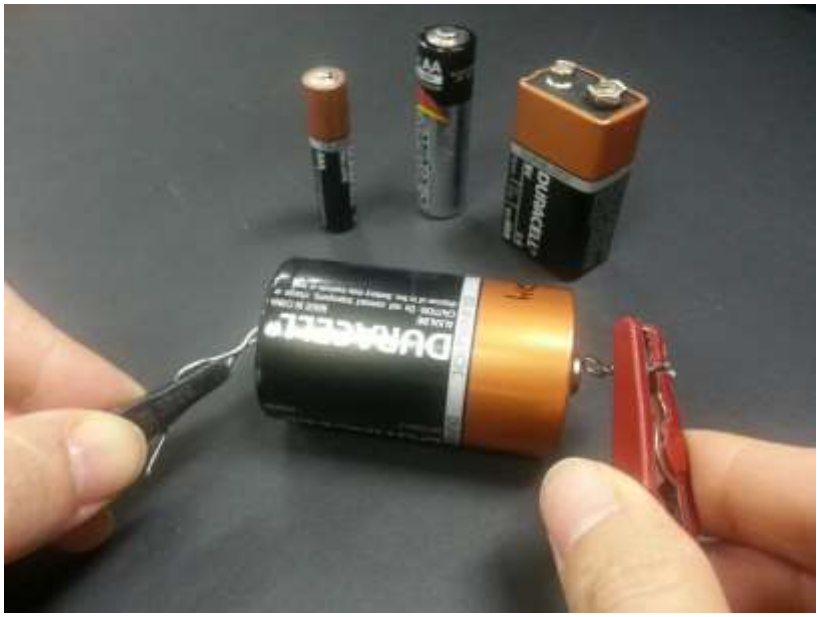
Conducting the Experiment

1. Read the voltage printed on the surface of four new types of batteries and record them in the table.

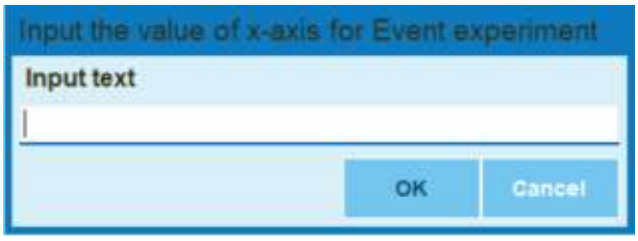
2. Attach the nichrome wire to both alligator clips of the voltage sensor (scrape off the coating on both ends of the nichrome wire with a knife).

3. Press the button  to zero the sensor..

4. Touch the nichrome wire connected to the alligator clips to the positive and negative terminals of the battery. Connect the red alligator clip wire of the voltage sensor to the positive terminal and the black clip wire to the negative terminal.



5. Press the button  to measure the voltage and record the battery name on the X-axis.



e.g., AAA battery

6. Measure and record the voltage of different types of batteries and used batteries in the same manner.

7. Press the stop button  to end the experiment.

Data Analysis

1. Measure the voltage of various types of batteries and used batteries, and represent the results in a bar graph for comparison.

2. Record the voltage printed on new batteries and the actual measured voltage in the table below.

Type	AAA	AA	D	FC-1
Printed Voltage (V)				
Measured Voltage (V)				

Observations

1. Write down the observations you made while measuring the voltage of various batteries.

2. Identify and list the devices around you that use batteries.


Report
(For Teachers)
Report
(For Students)