**Voltage, Current and Resistors in DC Circuit**

1. Students are asked about the concept of potential difference and relate voltage of batteries with potential difference.
2. Using Circuit Construction Kit (DC only), investigate
3. the relation between voltage and current

* Under “Advance” panel, hide the electrons.
* Guide the students to build a circuit with a battery, an ammeter (before the resistor) and a resistor.
* Change the voltage of the battery and observe the readings on ammeter.
* Record the readings of voltage of battery and ammeter’s readings and conclude the relation between *V* and *I*. Ask the students to predict the brightness of light bulb which replaces the resistor in the circuit when voltage is varied.
* The students are asked to change the resistance of resistor and observe the changes in *V* and *I* and form a hypothesis.
* Compare students’ hypothesis and the Ohm’s law. Provide some questions on Ohm’s law for exercise.

1. the idea of current being “used up”

* The students are asked their opinion of current being used up by resistors/light bulbs. The students are then asked to predict the outcome of the value of current before and after a resistor/light bulb.
* Students add an additional ammeter to the previous circuit after the resistor.
* From observation, discuss the idea of current being “used up” in group and between groups.

1. the relation between current and charges

* With the same circuit, under “Advance” panel, show the electrons.
* Changing the voltage of the battery to get different amount of current flowing in the circuit, observe the flow of the electrons.
* Ask the students to form hypotheses on conservation of charges and relation between charge *Q* and current *I*.
* Conclude the relation between *Q* and number of electrons, *ne*; *I* and *Q* with the equation *Q* = *It*. Provide some questions on *Q* and *I* for exercise.

1. the relation of current and resistor in series

* The students are asked to predict the value of current when an additional resistor is added in series into the previous circuit in between the battery and ammeter. Ask the students to verify their views through the circuit.
* To further impose the idea of current not being “used up” in the circuit, the students are asked to predict the reading of current after the second resistor. Allow the students to verify their understanding through circuit. Assist students to construct the idea of “sum of all resistance in series = total resistance”.
* Ask students to predict the resistance in series circuits. Provide some questions on resistance in series for exercise.

1. the relation between current and resistors in parallel

* The students are asked to remove the additional resistor from the circuit. The students are then asked to predict the value of current when an additional resistor is added in parallel into the initial circuit. Ask the students to verify their views through the circuit. Add an ammeter beside the new resistor. Ask the students to report their observation.
* The students are asked to predict the amount of current flowing through each resistor in parallel when the resistance of the resistors are made different.
* The students were to verify their prediction through circuit and report their findings.
* Assist students to construct the idea of “sum of all reciprocal of resistance in parallel = reciprocal of total resistance”.
* Provide some questions on resistance in parallel circuits for exercise.

1. Students are asked the predict the brightness of light bulbs or different arrangements towards the end of the class.
2. Reinforce the ideas and concepts in physics labs using batteries, connecting wires, ohmic resistors, ammeters, voltmeters and light bulbs.