

# ARISE Curriculum Coordination to Science of Atoms and Molecules (SAM) Project

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This document is laid out by SAM activity. For each activity, there is a list of labs, demonstrations, articles, and/or worksheets that will help support it. Usually, it is assumed that these supplementary materials will help students prepare for the SAM activity, so as to get the most from it. It is not expected that teachers will use all of the materials cited; rather, the compilers have tried to convey the wealth of material available in the *ARISE Instructional Materials Guide, Part 1: Physics* and *Part 2: Chemistry* that supports the SAM activities.

## SAM Activity: Electric Current

Prior to Day 1:

[ARISE Physics Topic 10: Electric Potential](#) (pdf)

Electric Potential Worksheet, *ARISE Instructional Materials Guide, Part 1 - Physics*

[ARISE Physics Topic 11: Current and Resistance](#) (pdf)

Electric Potential Worksheet, *ARISE Instructional Materials Guide, Part 1 - Physics*

Labs:

- Hsu Lab 13A, “Electricity.” Uses a battery switch and bulb to explore continuity and the conductivity of various materials. Introduces a multimeter to measure current and voltage. Introduces basic schematic symbols. Adds a potentiometer as a dimmer switch.
- Hsu Lab 13B, “Resistance and Ohm’s Law.” Uses a multimeter to measure the resistance of various materials. Uses the multimeter to measure the voltage across and current through several resistors placed one at a time in series with a battery. Students determine resistance of each. Measures the resistance of a potentiometer at several points. Plots resistance vs. rotation on a graph. Further studies the dimmer circuit introduced in 13A.
- Hsu Lab 15B, “Flow of Charge.” Uses a simple circuit with a capacitor and resistor and a battery. The capacitor is charged by the battery, and then used to energize the resistor while its voltage is monitored with a multimeter—the voltage is recorded each 10 s for a minute. The current is determined and the amount of charge transferred calculated.
- Hsu Lab 14B, “Electrical Energy and Power.” Measures current and voltage across a lamp connected to a battery. Explores power and energy calculations based on data. Adds a capacitor to the circuit and

explores the behavior of the bulb as the capacitor is charged and discharged. Introduces a timer and a second and third bulb wired parallel to each other to explore discharge rates of capacitor.

- “Ohm’s Law, Electrical Energy, and Power,” *ARISE Instructional Materials Guide, Part 1 - Physics*

#### SAM Theme Activities, Day 1:

Day 1 of the SAM materials generally follows the teaching of current electricity in the traditional physics curriculum but maintains the emphasis on the atomic level. Voltage, current, conductivity, and resistance are defined with examples, analogies, and simulations of what’s happening to electrons in different materials. The day ends with an investigation and derivation of Ohm's Law.

#### Prior to Day 2:

[ARISE Physics Topic 12: Direct Current Circuits](#) (pdf)

##### Labs:

- Hewitt Lab 87, “Sparky the Electrician.” The student explores the various means of connecting a battery, lamp and wires in order to light the lamp. Series and parallel arrangements are explored.
- Hewitt Lab 89, “Ohm Sweet Ohm.” A lamp in series with a mounted nichrome wire is connected to 1, 2, 3 or 4 battery cells to explore Ohm's Law.
- Hewitt Lab 90, “Getting Wired.” A simple circuit with lamps is constructed. The student is guided to make inferences regarding the movement of electric charge based on the behavior of the bulbs and of a magnetic compass placed near the wires.
- Hewitt Lab 91, “Cranking Up.” Parallel and series circuits with 1, 2 or 3 lamp bulbs are energized with a hand-cranked generator. A multimeter is used to measure current and voltage in support of Ohm's Law.
- Hsu Lab 14A, “Electric Circuits.” A battery, switch, multimeter and 1 to 3 lamp bulbs are used to explore the similarities and differences of series and parallel circuits.
- “Series and Parallel Circuits; (a) Light Bulbs and (b) Resistors,” *ARISE Instructional Materials Guide, Part 1 - Physics*. Circuits are set up with 1, 2 or 3 elements in series or in parallel on a breadboard. A multimeter collects data to evaluate the circuits.

#### SAM Theme Activities, Day 2:

Day 2 of the SAM materials covers electrical circuits. Kirchoff's Laws for Voltage and Current are given along with simulations of simple circuits. Atomic views of incandescence and hydrogen fuel technology are also introduced. The hydrogen fuel technology page “leans forward” towards what the chemistry students will learn during their sophomore year.