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

Prepared by Keith Kuykendall, Tinley Park High School, Tinley Park, IL and
Jason English, William Fremd High School, Palatine, IL
Edited by Spencer Pasero and LaMargo Gill

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: Gas Laws

SAM Theme Activities:
The SAM module for Gas Laws does a very nice job of introducing Boyle's Law, Avogadro's Law, Charles's Law and Gay–Lussac's Law. Prior to proceeding with this series of simulations, it would be helpful for the student to have a grasp of the concept of kinetic energy. Some experience from physics dealing with collisions (particularly elastic collisions, but really any type of study that allows the student to see that collisions produce forces between objects). The student should recognize that gas pressure is the sum of forces produced by molecular collisions upon an area of surface. A student might be introduced to the mole before engaging in the page 6 activity, or the page 6 activity could set the stage for the introduction of the mole.

With the Topic:

ARISE Chemistry Topic 7: Moles (pdf)

Demonstrations:

- *Flinn ChemTopic Labs*, Vol. 7, “Stoichiometry Balloon Races.” This demo gives kids a visual feel for limiting reagents using common household chemicals.

Articles:

- *ChemMatters*, October 1985, pp. 14–15, “Bringing Helium Down to Earth.”

ARISE Chemistry Topic 12: Gases, Gas Laws, and Kinetic Theory (pdf)

Labs:

- *ChemMatters*, April 2002, p. 6, “Try it! Make Your Own Hot Air Balloon.” Contains directions for constructing and flying a hot air balloon, along

with some possible extensions of the activity. The teacher's guide contains links to possible alternate activities.
- *Flinn ChemTopic Labs*, Vol. 9, "Boyle's Law in a Bottle." Boyle's Law is "discovered " in a tactile way using a syringe, pump, pressure gauge and a soda bottle.
- *Flinn ChemTopic Labs*, Vol. 9, "Charles's Law and Absolute Zero." Charles's Law is developed using a syringe and different temperature water baths to find a value for absolute zero.
- *Flinn ChemTopic Labs*, Vol. 9, "Molar Volume of Hydrogen." In this microscale lab, students collect a known amount of hydrogen and find the molar volume of hydrogen gas at STP.
- *Flinn ChemTopic Labs*, Vol. 9, "Technology and the Forgotten Gas Law." Amonton's Law, which relates pressure and temperature, is derived using a technology–based experiment.
- *Flinn ChemTopic Labs*, Vol. 9, "Life on Planet V." To understand the concepts of a vacuum and atmospheric pressure, an inquiry–based "mental lab" asks a series of questions about Planet V that has no atmosphere. How would it be to live in such an environment?
- *Flinn ChemTopic Labs*, Vol. 9, "Construction of Gas Volume Cubes." A tactile activity where the students construct cubes to represent the volume taken up by different numbers of moles of gas.

Demonstrations:
- *Flinn ChemTopic Labs*, Vol. 9, "The Collapsing Can." A can filled with hot water vapor is crushed as it cools, due to atmospheric pressure.
- *Flinn ChemTopic Labs*, Vol. 9, "Massing Gases." A syringe is used to find the molar mass of an unknown gas using Avogadro's Law.
- *Flinn ChemTopic Labs*, Vol. 9, "Molar Mass of Butane." Using the Ideal Gas Law, the molar mass of butane (obtained from a lighter) is calculated.
- *Flinn ChemTopic Labs*, Vol. 9, "Diffusion of Gases." The two gases HCl and NH3 are used in a glass tube. Measurements are made of their rates of diffusion. Varying the temperature changes the rate of diffusion.
- *Flinn ChemTopic Labs*, Vol. 9, "Cartesian Divers." Cartesian divers are built and used to show Boyle's Law.

Articles:
- *ChemMatters*, October 1983, pp. 4–7, "An Atomic Tour."
- *ChemMatters*, October 1984, pp. 10–13, "Popcorn."
- *ChemMatters*, February 2000, pp. 4–6, "Mt. Everest: Climbing in Thin Air."
- *ChemMatters*, February 2000, p. 16, "Why Do Eggs Take Longer to Cook in the Mountains?"
- *ChemMatters*, December 2000, p. 12, "Noisy Knuckles and Henry's Law."
- *ChemMatters*, February 2001, pp. 4–6, "Cartesian Divers: Squeeze

Play."
- *ChemMatters*, February 2002, p. 2, "Hydrogen Beer."
- *ChemMatters*, April 2002, pp. 4–5, "Hot Air Balloons: Gas and Go."