

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: Atomic Structure

Prior to Day 1:

ARISE Physics Topic 20: The Atom

<http://ed.fnal.gov/arise/guide.html>

The Atom Worksheet, *ARISE Instructional Materials Guide, Part 1 - Physics*
Labs:

- Hewitt Lab 97, "Nuclear Marbles." The Rutherford Gold Foil Experiment is explored by shooting marbles blindly at one another and estimating the diameter of the target marbles using probability equations and the frequency of collisions.
- Hewitt Lab 98, "Half-Life." Half-Life is modeled with a collection of 200 pennies. The results of ten trials (after which pennies turned to heads are removed) are graphed.
- Hewitt Lab 99, "Chain Reaction." A nuclear chain reaction is simulated using dominoes.
- "Hydrogen's Lowest Energy Level," *ARISE Instructional Materials Guide, Part 1 - Physics*. A mounted diffraction grating and a hydrogen emission tube are used to determine the wavelength of visible emissions from excited hydrogen atoms. The frequency and energy of those photons is subsequently calculated.

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ARISE Chemistry Topic 4: Atomic Structure

<http://ed.fnal.gov/arise/guide.html>

Labs:

- *Flinn ChemTopic Labs*, Vol. 3, “Bean Bag Isotopes.” Students investigate relative abundance of isotopes for a “bean bag” element and calculate its atomic mass.
- *Flinn ChemTopic Labs*, Vol. 3, “Atomic Target Practice.” A “black box” activity/ experiment used to discover by indirect means the size and shape of an unknown object. By tracing the apparent path a marble takes after striking the unseen target from a variety of angles, students can estimate the general size and shape of the target. It is used to simulate the experiment that led to Rutherford’s model for the structure of the atom.
- *Flinn ChemTopic Labs*, Vol. 3, “Quantum Leap Lab.” Students drop marbles onto a target to investigate by analogy the relationship between probability and electron structure. The pattern of marble drops on the target sheets simulates the three–dimensional properties of atomic orbitals.

<http://www.flinnsci.com/Sections/Chemistry/chemTopicLabs.asp>

SAM Theme Activities, Day 1:

Day 1 of the SAM materials begins by ensuring students have a proper view of the atom with the introduction of Schrodinger's electron cloud model and explanation of it. The structures of some different elements are investigated and followed by activities familiarizing students with ions and isotopes. Connections to biology are also made with some discussion of carbon–14 dating.

Prior to Day 2:

ARISE Chemistry Topic 4: Atomic Structure

Articles:

- *ChemMatters*, April 2000, pp. 6–9, “Radioactivity, It’s a Natural.” Article treats radioactivity, what it is, how it is produced, the most common types (alpha, beta, gamma), and their characteristics. It presents some of the history behind the discovery and characterization of radioactivity, the sources of radioactivity in our environment, the possible biological effects of exposure, and ends with a worksheet.
- *ChemMatters*, October 2000, pp. 4–5, “The Birth of the Elements.” Article deals with the origins of the elements, starting with hydrogen and helium and then to the stellar synthesis of heavier elements and on to the formation of even heavier elements in events such as supernovae.

ARISE Chemistry Topic 5: Radioactivity, Fusion, & Fission

<http://www.acs.org/chemmatters>

Articles:

- *ChemMatters*, October 1998, pp. 13–15, “The Radium Girls, Dialing Up Trouble.” Article is about the “radium girls” who painted the hands of watches with radium salts and the terrible physical consequences they suffered because of their absorption of radioactive alpha emitters into their bodies.

- *ChemMatters*, April 1999, p. 16, "Should Food be Irradiated?" Article explains what happens when food is irradiated and tries to dispel irrational fears based on inaccurate science.

ARISE Chemistry Topic 14: Periodicity, the Periodic Law, Metals, Nonmetals, and Families

<http://www.flinnsci.com/Sections/Chemistry/chemTopicLabs.asp>

Labs:

- *Flinn ChemTopic Labs*, Vol. 4, "It's in the Cards." This inquiry lab helps students to experience the thought process that Mendeleev went through in developing the periodic table.
- *Flinn ChemTopic Labs*, Vol. 4, "Density Is a Periodic Property." This lab helps students to experience the thought process that Mendeleev went through in developing the periodic table and why he is credited with it rather than others.
- *Flinn ChemTopic Labs*, Vol. 4, "Periodic Trends and the Properties of Elements." This microscale lab helps students to see why Mendeleev would have classified these metals as a group in developing the periodic table. It also serves to introduce the activity series and reinforce reaction types.
- *Flinn ChemTopic Labs*, Vol. 4, "All in the Family." These microscale labs help students to see why Mendeleev would have classified these elements as a group in developing the periodic table. It also serves to introduce the activity series and, by the students carrying out the reactions, reinforces learning of reaction types.

Demonstrations:

- *Flinn ChemTopic Labs*, Vol. 4, "Periodic Activity of Metals." This demo helps students to see why Mendeleev would have classified these metals into groups while developing the periodic table. It also serves to introduce the activity series and reinforce reaction types and acid/base reactions.
- *Flinn ChemTopic Labs*, Vol. 4, "Safe Swimming with Sodium." This demo helps students to see a classic demo of sodium in water in a safe and interesting way.
- *Flinn ChemTopic Labs*, Vol. 4, "Plotting Trends." This demo helps students to see a 3-D picture of the periodic properties.
- *Flinn ChemTopic Labs*, Vol. 4, "Solubility Patterns." This demo is microscale.

SAM Theme Activities, Day 2:

Day 2 of the SAM materials focuses on electron orbitals. Students are able to see the shapes of different orbitals as they "build" atoms and learn that orbital shape is dependent on electron energy. The organization of the periodic table is discussed from the view of the shape of the electron orbitals. There also is an interactive periodic table from which students can see what many different elements look like at the atomic level.