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

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SAM Activity: Intermolecular Attractions

SAM Theme Activities, Day 1:
The first day of the SAM project, Van der Waals' Forces module introduces the basic intermolecular interactions. Prior to participation in this module, the student needs a basic qualitative understanding of electrostatics and should know that atoms are made of positively charged nuclei surrounded by negatively charged electrons. It should make sense to the student that a partial negative charge will form in regions where electron density is higher than average and a partial positive charge will form where the electron density is smaller than average relative to the number of protons nearby. The module emphasizes the relationship between boiling point and intermolecular forces, so a good grasp of what we mean by "boiling" is important. The SAM module on electrostatics is itself more than sufficient to support most of the background required for this unit.

With Day 1:

ARISE Chemistry Topic 10: Phases: Solids, Liquids, and Gases (pdf)

Labs:

- *ChemCom*, Fourth Edition, Unit III, Section A, Lab A.2, p. 178, "Separation by Distillation." In this lab students are given a mixture of two liquids and asked to separate and identify the liquids based on boiling points and reaction with iodine.

ARISE Chemistry Topic 16: Covalent Bonds, Molecular Shapes, and Intermolecular Forces (pdf)

Articles:

- *ChemMatters*, February 1985, pp. 4–7, 12, "Soap."
- *ChemMatters*, December 1987, pp. 10–13, "Polywater."
- *ChemMatters*, December 1993, pp. 6–9, "Microwaves."
- *ChemMatters*, April 1994, pp. 8–9, "Magic Sand."
- *ChemMatters*, February 1997, pp. 9–12, "The Disappearing Fingerprints."
- *ChemMatters*, April 1997, pp. 4–7, "Lava Lite: A Chemical Juggling Act."
- *ChemMatters*, December 2002, pp. 4–6, "Images of Anthrax."
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ARISE Chemistry Topic 17: Water and Aqueous Solutions (pdf)

Labs:

- *Flinn ChemTopic Labs*, Vol. 12, “It’s in Their Nature.” Students study the solubility patterns of ionic, polar, and nonpolar compounds in a variety of solvents to understand the types of intermolecular attractive forces that exist.
- *Flinn ChemTopic Labs*, Vol. 12, “Factors Affecting Solution Formation.” In this inquiry–based experiment, students must design a series of tests to investigate how changing the crystal size of the solute, the temperature of the solvent, or the mixing of the solution will affect the rate at which copper sulfate dissolves. The results help students understand how and why solutions form.

Articles:

- *ChemMatters*, April 2001, p. 2, “Is Water the Best Fire Extinguisher in the Kitchen?”
- *ChemMatters*, February 2002, pp. 8–9, “Maple Syrup: Sweet Sap Boils Down to This.”

SAM Theme Activities, Day 2:

Day 2 of the SAM project materials examines the hydrogen bond with emphasis on the fact that it is a strong intermolecular force that is still much weaker than an "intramolecular" covalent bond. The module goes on to explore the importance of hydrogen bonds in the function of antigen–antibody interactions and in the workings of DNA. Besides the basics of electrostatics that precede the day 1 activities, the student proceeding with the second day of these activities should have a sound understanding of the concept of electronegativity. The instructor should call attention to the charge distribution of highly polar bonds involving hydrogen, oxygen and nitrogen as examples of the types of molecules that will be susceptible to hydrogen bonding in a natural system.

With Day 2:

ARISE Chemistry Topic 16: Covalent Bonds, Molecular Shapes, and Intermolecular Forces (pdf)

Articles:

- *ChemMatters*, February 1988, pp. 4–8, “Artificial Sweeteners.”
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ARISE Chemistry Topic 17: Water and Aqueous Solutions (pdf)

Demonstrations:

- *Flinn ChemTopic Labs*, Vol. 12, “Sorting Out Solutions.” A two–part demonstration to show the effect of hydrogen bonding and other intermolecular forces on the properties of solutions. When 50 ml of glycerol and 50 ml of water are mixed, the volume of the resulting solution should be 100 ml, but it turns out to be 4 percent less! Ethyl alcohol and water are miscible. Add an ionic solute to the solution, however, and the solution separates into two layers.