ARISE Curriculum Guide

Chemistry: Topic 16—Covalent Bonds, Molecular Shapes and Intermolecular Forces

ChemMatters

Order a CD with 25 years of ChemMatters, $30

Articles for Student Use

Artificial Sweeteners: Feb. 1988, pp. 4-8.
An Atomic Tour: Oct. 1983, pp. 4-7.
Buckeyballs: Dec. 1992, pp. 7-11.
The Disappearing Fingerprints: Feb. 1997, pp. 9-12.
The Explosive History of Nitrogen: Feb. 2003, pp. 8-10.
Images of Anthrax: Dec. 2002, pp. 4-6.
Lava Lite: A Chemical Juggling Act: April 1997, pp. 4-7.
Magic Sand: April 1994, pp. 8-9.
Mirror Molecules: April 1989, pp. 4-7.
Permanent Waves: April 1993, pp. 8-11.
Polywater: Dec. 1987, pp. 10-13.
Silly Putty: April 1986, pp. 15-19.
Soap: Feb. 1985, pp. 4-7, p. 12.

Articles for Teacher Use

Number and Topic:	**1. Matter and Change (Classification of Matter)** **10. Phases, Solids, Liquids and Gases (States of Matter)** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces,** **17. Water, Aqueous Solutions**
Source:	*ChemMatters*, Dec. 1987, pp. 10-13, "Polywater"
Type of Material:	Student Journal Article
Building on:	Basic properties of water
Leading to:	Discovery of "polywater" and how its existence was disproved
Links to Physics:	Density, spectra
Links to Biology:	
Good Stories:	Entire article is a "good story."
Activity Description:	This article relates the story behind the discovery of "polywater." It goes into the evidence for its existence, the excitement and hype that accompanied its reported discovery, the enthusiastic acceptance of its existence by some scientists versus the skepticism of others, and how its existence was eventually disproved. Although the article contains a lot of science content and information about the properties of water, its greatest value may very well lie in its exposition of the fact that at times science may take a wrong turn; it includes self-correcting features that work strongly towards correcting errors and arriving at the truth.

Number and Topic:	**4. Atomic Structure** **13. Electrons in Atoms** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**
Source:	*ChemMatters*, Sep. 2001, pp. 4-6, "Spectroscopy: Sensing the Unseen"
Type of Material:	Student Journal Article
Building on:	Atomic Structure
Leading to:	Discussion of how electromagnetic radiation allows us to detect the presence of different molecules in the atmosphere
Links to Physics:	Electromagnetic spectrum, atoms, light, motion and forces
Links to Biology:	Except that the atmosphere is a very important part of our ecosystem, and any change in the atmosphere can have significant effects upon life on earth.
Good Stories:	
Activity Description:	The article discusses the electromagnetic spectrum and how the interaction of light with matter can be used to detect and measure gases present in earth's atmosphere. This is then connected to the NASA EOS-Aura project, a project that will launch a satellite that will carry four state-of-the-art instruments designed to make sophisticated measurements of earth's atmosphere.

Number and Topic:	**4. Atomic Structure** **6. Chemical Names and Formulas/Compounds and Elements** **10. Phases, Solids, Liquids and Gases (States of Matter)** **12. Gases/Gas Laws/Kinetic Theory** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **17. Water, Aqueous Solutions**
Source:	*ChemMatters*, Oct. 1983, pp. 4-7, "An Atomic Tour"
Type of Material:	Student Journal Article
Building on:	Basic knowledge of atomic and molecular structures
Leading to:	Modeling, molecular motions, Bolzmann's distribution, composition of air, structure of water, polarity, hydrogen bonds, structure of ice
Links to Physics:	
Links to Biology:	
Good Stories:	
Activity Description:	This article, written by the late Isaac Asimov, takes the reader on an imaginary journey where he/she becomes smaller and smaller until he/she can see individual atoms and molecules. The article goes on to describe several molecular structures and motions.

Number and Topic:	**8. Chemical Reactions** **15. Ionic and Metallic Bonds** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **20. Acids/Bases/pH** **21. Organic Chemistry** **22. Redox/Electrochemistry**
Source:	*ChemMatters*, April 1993, pp. 8-11, "Permanent Waves"
Type of Material:	Student Journal Article
Building on:	Molecular structures, acids and bases
Leading to:	Hydrogen bonds, amino acids, proteins,
Links to Physics:	
Links to Biology:	Structure of human hair, proteins
Good Stories:	
Activity Description:	Article details the complex structure of human hair and how permanent waves act on hair to produce their effect.

Number and Topic:	**6. Chemical Names and Formulas/Compounds and Elements** **8. Chemical Reactions** **11. Thermochemistry** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **18. Reaction Rates and Kinetics**
Source:	*ChemMatters*, Feb. 2003, pp. 8-10, "The Explosive History of Nitrogen"
Type of Material:	Student Journal Article
Building on:	Basic chemical knowledge
Leading to:	Discussion of bonding in nitrogen compounds and elemental nitrogen, thermochemistry and reaction rates.
Links to Physics:	Matter, energy, entropy
Links to Biology:	
Good Stories:	What caused a terrible explosion aboard a cargo ship loaded with ammonium nitrate on April 16, 1947, killing 576 people?
Activity Description:	Article deals with explosive nitrogen-containing compounds and the chemical reasons that underlie their explosive nature.

Number and Topic:	**6. Chemical Names and Formulas/Compounds and Elements** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**
Source:	*ChemMatters*, Dec. 1992, pp. 7-11, "Buckyballs"
Type of Material:	Student Journal Article and Activity
Building on:	Geometry, Families of elements
Leading to:	Mass spectroscopy, Structure and properties of Buckyballs, an unusual allotrope of carbon
Links to Physics:	Matter, isotopes
Links to Biology:	
Good Stories:	Interesting story about how the research that led to the discovery of buckyballs was considered to be so trivial that it took eighteen months for the person doing the research to get to use the required equipment.
Activity Description:	Article describes how buckyballs were discovered, their structure, their properties, and some potential uses. It goes into the geometry of truncated icosahedrons. It should be noted that the article is actually a bit out of date, since much research has been done since it was published. It also includes a student activity to build a model of a buckyball and provides the necessary template.

Number and Topic:	**8. Chemical Reactions** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **17. Water, Aqueous Solutions** **21. Organic Chemistry**
Source:	*ChemMatters*, Feb. 1985, pp. 4-7, p. 12, "Soap"
Type of Material:	Student Journal Article and Activity
Building on:	Basic chemical knowledge of structures
Leading to:	Polarity, intermolecular forces, "like dissolves like," saponification
Links to Physics:	
Links to Biology:	
Good Stories:	Early bathing habits. Queen Isabella of Spain boasted of taking only two baths in her lifetime, once when she was born and another on her wedding day. Queen Elizabeth I of England was a "bathing enthusiast." Her chronicles record that "she hath a bath every three months whether she needeth it or no."
Activity Description:	This article presents both the history of soap making, the science of soap making, including typical chemical equations, and the "art" of soapmaking. On page 12 there is a student activity relating to how soap works.

Number and Topic:	**10. Phases, Solids, Liquids and Gases (States of Matter)** **16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **21. Organic Chemistry**
Source:	*ChemMatters*, April 1986, pp. 15-19, "Silly Putty"
Type of Material:	Student Journal Article
Building on:	Basic chemical knowledge
Leading to:	Elastomers, dilatancy
Links to Physics:	Forces; why silly putty will stretch if pulled slowly but snap if pulled quickly
Links to Biology:	
Good Stories:	How the material from which Silly Putty is made was considered just a laboratory curiosity until a person observing it just for fun saw its potential as a children's toy.
Activity Description:	This article discusses Silly Putty. It explains its unusual properties and relates these properties to its molecular structure.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**
Source:	*ChemMatters*, Dec. 2002, pp. 4-6, "Images of Anthrax"
Type of Material:	Student Journal Article
Building on:	Chemical formulas
Leading to:	Covalent bonds and molecular shapes
Links to Physics:	Matter, atoms
Links to Biology:	Protein synthesis, adaptations
Good Stories:	Entire article is a "good story"
Activity Description:	Students in a Milwaukee, WI area high school undertook a project to build the first models of three anthrax-related proteins. The article describes their efforts, experiences, and successes. Very good as a "role model" article for students.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**
Source:	*ChemMatters*, Feb. 1997, pp. 9-12, "The Disappearing Fingerprints"
Type of Material:	Student Journal Article
Building on:	Polar and non-polar compounds
Leading to:	Discussion of gas chromatography, mass spectrometry and organic chemistry
Links to Physics:	
Links to Biology:	Difference between the kinds of oil contained in the skin of children vs. adults.
Good Stories:	Relates the disappearance of fingerprints from a child abduction case and how it led to a scientific study of how the chemicals contained in a child's prints are different from those contained in an adult's.
Activity Description:	Article relates how the police were perplexed when they could not find a child's fingerprints inside an abductor's car from which they were certain she had escaped. The article goes on to discuss the difference between the composition of the mixture of chemicals that make up a child's prints vs. that of an adult.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**
Source:	*ChemMatters*, April 1994, pp. 8-9, "Magic Sand"
Type of Material:	Student Journal Article
Building on:	Covalent bonds
Leading to:	Intermolecular forces, organic groups
Links to Physics:	Density
Links to Biology:	
Good Stories:	Relates how "Magic Sand" is created.
Activity Description:	Article discusses the nature of "Magic Sand," sand that repels water. It discusses how it is created, how and why it has the properties it does, and some practical uses of the product.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **21. Organic Chemistry**
Source:	*ChemMatters*, April 1989, pp. 4-7, "Mirror Molecules"
Type of Material:	Student Journal Article
Building on:	Molecular structures
Leading to:	Optical isomerism, chirality
Links to Physics:	
Links to Biology:	Chirality in nature, such as is found in some shells and umbilical cords
Good Stories:	
Activity Description:	Article discusses "mirror image" molecules and how chirality is found in nature.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **21. Organic Chemistry**
Source:	*ChemMatters*, Feb. 1988, pp. 4-8, "Artificial Sweeteners"
Type of Material:	Student Journal Article and Activity
Building on:	Organic chemistry
Leading to:	Hydrogen bonds, optical isomers
Links to Physics:	
Links to Biology:	Why some molecules taste sweet, the "sweetness triangle"
Good Stories:	How the early Romans used lead acetate to sweeten their food—possibly contributing to the downfall of the Roman Empire.
Activity Description:	Article discusses various kinds of natural and artificial sweeteners, their molecular structures and shapes as well as the history behind their discovery and in some cases their eventual banning by the FDA.

Number and Topic:	**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces** **17. Water, Aqueous Solutions** **21. Organic Chemistry**
Source:	*ChemMatters*, April 1997, pp. 4-7, "Lava Lite: A Chemical Juggling Act"
Type of Material:	Student Journal Article
Building on:	Polar and nonpolar bonds and compounds, "like dissolves like"
Leading to:	Organic molecules and their structures
Links to Physics:	
Links to Biology:	
Good Stories:	Tells story of the invention of the lava lamp and its high popularity during the "Age of Aquarius" 1960s. A highly guarded secret, the composition of the materials inside the lamp were determined when an alcoholic drank a lamp's contents and the composition of the contents needed to be ascertained in order to save the man's life.
Activity Description:	Article describes the structure of lava lamps and how their operation is related to the molecular structures and densities of the materials inside the lamp.

Flinn ChemTopic Labs

Order Flinn ChemTopic Labs

Demo: Acid in the Eye – Safety
Demo: A Burning Candle - Observations
Demo: Classifying Matter
Demo: Flaming Vapor Ramp—Safety Demo
Lab: Observation and Experiment - Introduction to the Scientific Method
Lab: Separation of a Mixture - Percent Composition
Lab: What is a Chemical Reaction - Evidence of Change
Lab: Common Gases—Physical and Chemical Properties
Lab: Preparing and Testing Hydrogen Gas—A Microscale Approach
Lab: Carbon Dioxide - What a Gas—Microscale Gas Chemistry

ICE LABS

Online Descriptions and Experiments

No activities on this topic.

Technology-Adapted Labs

No activities on this topic.