

ARISE Curriculum Guide

Chemistry: Topic 6—Chemical Names and Formulas/Compounds and Elements

ChemMatters

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Articles for Student Use

- An Atomic Tour: Oct. 1983, pp. 4-7.
Are Living and Nonliving Things Composed of Entirely Different Substances? Dec. 1999, p. 16.
Breakfast of Crystals: Oct. 1983, pp. 8-12.
Buckyballs: Dec. 1992, pp. 7-11.
Burning Diamonds and Squeezing Peanuts: April 1990, pp. 14-15.
Carbon Dioxide: A Pourable Greenhouse Gas: Sep. 2001, pp. 10-11.
Detergents: April 1985, pp. 4-6.
Dinosaurs and Iridium, Traces of an Impact: Feb. 2001, pp. 12-13.
The Explosive History of Nitrogen: Feb. 2003, pp. 8-10,
Global Warming: Hot Topic Getting Hotter: Sep. 2001, pp. 14-15.
Happy Birthday Helium: Dec. 1995, p. 12.
Hydrogen Fuel Cells for Future Cars: Dec. 2000, pp. 4-6.
Iron for Breakfast: Oct. 1994, pp. 13-15.
Making Ice Cream: Dec. 1995, pp. 4-7.
Matches. Striking Chemistry at Your Fingertips: Dec. 2002, pp. 14-16.
The New Gold Rush: Oct. 1989, pp. 4-4-8.
Nitrous Oxide: By no Means a Laughing Matter: Feb. 1986, pp. 17-19.
Ozone: Molecule with a Split Personality: Sep. 2001, pp. 7-9.
Real Leather: April 1990, pp. 4-6.
Salt: Dec. 1992, pp. 4-6.

Articles for Teacher Use

Number and Topic: 1. Matter and Change
6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions
10. Phases, Solids, Liquids and Gases (States of Matter)
11. Thermochemistry,

Source: *ChemMatters*, Dec. 2002, pp. 14-16, "Matches. Striking Chemistry at Your Fingertips"

Type of Material: Student Journal Article

Building on: Chemical names and formulas/compounds and elements, chemical reactions and thermochemistry

Leading to: Reaction rates, redox reactions

Links to Physics: Matter, energy, thermodynamics, heat

Links to Biology:

Good Stories: Entire article is a "good story"

Activity Description: Article describes the history of the development of the common match, covering early matches and their inherent weaknesses and dangers. Good review of chemical equations and/or a review or introduction to redox reactions.

Number and Topic: 3. Problem Solving
6. Chemical Names and Formulas/Compounds and Elements

Source: *ChemMatters*, Sep. 2001, pp. 14-15, "Global Warming: Hot Topic Getting Hotter"

Type of Material: Student Journal Article

Building on: Basic properties of carbon dioxide

Leading to: Effect of global warming on ecosystems

Links to Physics: Electromagnetic radiation

Links to Biology: Ecosystems

Good Stories: Entire article is a "good story."

Activity Description: The article describes the phenomenon of global warming, both from a theoretical and a measurable basis. It goes on to discuss changes in our atmosphere, possible interpretations of what has caused these changes, and the potential consequences that might be attached to them.

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, Boltzmann'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: 5. Radioactivity, Fusion, Fission
6. Chemical Names and Formulas/Compounds and Elements
14. Periodicity/Periodic Law/Metals, Non-metals and Families

Source: *ChemMatters*, Dec. 1995, p. 12, "Happy Birthday Helium"

Type of Material: Student Journal Article

Building on: Elements

Leading to: Spectroscopy

Links to Physics: Electromagnetic spectrum, sun, atoms

Links to Biology:

Good Stories: Relates how helium was discovered in the sun before it was actually discovered on earth!

Activity Description: Article relates the discovery of helium, its source on earth, and some of its very unusual properties.

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
8. Chemical Reactions
12. Gases/Gas Laws/Kinetic Theory
18. Reaction Rates and Kinetics and Kinetics and Kinetics

Source: *ChemMatters*, Sep. 2001, pp. 7-9, "Ozone: Molecule with a Split Personality"

Type of Material: Student Journal Article

Building on: Elements and compounds, chemical reactions, gases

Leading to: Reaction rates, chemical kinetics

Links to Physics: Atoms

Links to Biology: Animals, plants, photosynthesis, ecosystems

Good Stories: Lots of excellent "real-life" connections such as sunburn and pollution

Activity Description: The article describes how ozone is both formed and destroyed in the stratosphere and how it is formed in our immediate breathable atmosphere by the action of sunlight on various pollutants. It explains why ozone in the stratosphere is good, while ozone at street level is harmful. It discusses what is actually happening to earth's protective layer of ozone and why.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions
12. Gases/Gas Laws/Kinetic Theory

Source: *ChemMatters*, Sep. 2001, pp. 10-11, "Carbon Dioxide: A Pourable Greenhouse Gas"

Type of Material: Lab

Building on: Measurement, properties of compounds

Leading to: Chemical reactions

Links to Physics: Measurement

Links to Biology:

Good Stories:

Activity Description: Students generate carbon dioxide through a simple chemical reaction. They study its properties, both physical and chemical.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements

Source: *ChemMatters*, Feb. 2001, pp. 12-13, "Dinosaurs and Iridium. Traces of an Impact"

Type of Material: Student Journal Article

Building on: Elements

Leading to: Examination of how a controversial scientific theory is tested and eventually accepted

Links to Physics:

Links to Biology: Ecosystems, adaptations, evolution

Good Stories: Entire article is a "good story."

Activity Description: Article describes how Walter Alvarez hypothesized that the mass extinction that occurred about 65 million years ago was caused by a meteor impact. At first ridiculed, his theory eventually became widely accepted, and the article goes through the experimental data and scientific arguments that carried the day.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements

Source: *ChemMatters*, Dec. 1999, p. 16, "Are Living and Nonliving Things Composed of Entirely Different Substances?"

Type of Material: Student Journal Article

Building on: Elements

Leading to: Bonding in carbon compounds

Links to Physics: Atoms, subatomic particles

Links to Biology: Living matter

Good Stories:

Activity Description: Article discusses similarities and differences between the "top ten" elements contained in the human body and the top ten elements in the earth's crust.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
10. Phases, Solids, Liquids and Gases (States of Matter)
17. Water, Aqueous Solutions
21. Organic Chemistry

Source: *ChemMatters*, Dec. 1995, pp. 4-7, "Making Ice Cream"

Type of Material: Student Journal Article and Activity

Building on: Basic chemical knowledge of molecular structures

Leading to: Colloids, lipids, emulsifiers, sugars, colligative properties

Links to Physics:

Links to Biology: Food, lipids, proteins

Good Stories: Relates the history of ice cream and some government regulations regarding the labeling of the product.

Activity Description: Article discusses the composition of ice cream and the science behind its preparation and ends with a student activity to make home-made ice cream.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions
13. Electrons in Atoms
17. Water, Aqueous Solutions
18. Reaction Rates and Kinetics
22. Redox/Electrochemistry

Source: *ChemMatters*, Oct. 1994, pp. 13-15, "Iron for Breakfast"

Type of Material: Student Journal Article and Activity

Building on: Chemical names and formulas, electrons in atoms

Leading to: Catalysis, redox reactions

Links to Physics: Magnetism

Links to Biology: Hemoglobin, the function of iron in human biology

Good Stories:

Activity Description: Article relates the nature of iron in human metabolism and the biological effects of having too much or too little.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
15. Ionic and Metallic Bonds

Source: *ChemMatters*, Dec. 1992, pp. 4-6, "Salt"

Type of Material: Student Journal Article

Building on: Formulas and properties of ionic solids

Leading to: Comparison of different salt substitutes

Links to Physics:

Links to Biology: Effect of salt on blood pressure

Good Stories:

Activity Description: Article describes the composition of "salt," different kind of "salt substitutes," and the biological effects of salt.

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:

Activity Description:

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. 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: 6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions

20. Acid/Bases/pH

21. Organic Chemistry

Source: *ChemMatters*, April 1990, pp. 4-6, "Real Leather"

Type of Material: Student Journal Article

Building on: Names and formulas, chemical reactions, acids, bases, pH

Leading to: Organic chemistry

Links to Physics: Structure of collagen, amino acids

Links to Biology: Relates the history of leather tanning from ancient times to the present.

Good Stories:

Activity Description: Article describes various techniques that can be used to tan leather, going into the chemical reactions involved in different processes.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
11. Thermochemistry

Source: *ChemMatters*, April 1990, pp. 14-15, "Burning Diamonds and Squeezing Peanuts"

Type of Material: Student Journal Article

Building on: Elements, allotropes

Leading to: Thermodynamics of converting graphite into diamonds, phase diagrams

Links to Physics:

Links to Biology:

Good Stories:

Activity Description: This article is an extension of the article, "Burning Diamonds and Squeezing Peanuts" that precedes it. It goes into more thermodynamic detail regarding the conversion of graphite into diamonds, including the phase diagram for the diamond-graphite-liquid system.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions
20. Acid/Bases/pH
22. Redox/Electrochemistry

Source: *ChemMatters*, Oct. 1989, pp. 4-4-8, "The New Gold Rush"

Type of Material: Student Journal Article

Building on: Chemical reactions

Leading to: Acids, bases, redox

Links to Physics:

Links to Biology: How bacteria can actually be used in some gold recovery processes

Good Stories:

Activity Description: Article discusses the history of gold mining, from crude early methods to modern sophisticated processes, going into detail about the chemical reactions and various processes that are employed.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
8. Chemical Reactions

Source: *ChemMatters*, Feb. 1986, pp. 17-19, "Nitrous Oxide: By no Means a Laughing Matter"

Type of Material: Student Journal Article

Building on: Chemical formulas

Leading to: Properties of different oxides of nitrogen and practical uses of these compounds

Links to Physics:

Links to Biology: Biological effects of the ingestion of nitrous oxide

Good Stories: Early attempts to develop anesthetics

Activity Description: This article discusses various oxides of nitrogen, their formulas and uses, with an emphasis on nitrous oxide.

Number and Topic: 6. Chemical Names and Formulas/Compounds and Elements
17. Water, Aqueous Solutions
20. Acids/Bases/pH
21. Organic Chemistry

Source: *ChemMatters*, April 1985, pp. 4-6, "Detergents"

Type of Material: Student Journal Article

Building on: Basic knowledge of molecular structures and ions

Leading to: Discussion of anionics, cationics, nonionics, emulsions, micelles, hard water

Links to Physics:

Links to Biology: Eutrophication caused by the presence of phosphates in detergents, bacterial action on surfactants

Good Stories:

Activity Description: Article discusses detergents, what they contain, the function of each ingredient and how they are different from soaps.

Number and Topic **6. Chemical Names and Formulas/Compounds and Elements**
10. Phases, Solids, Liquids and Gases (States of Matter)
15. Ionic and Metallic Bonds

Source: *ChemMatters*, Oct. 1983, pp. 8-12, "Breakfast of Crystals"

Type of Material: Student Journal Article and Activity

Building on: Basic knowledge of chemical formulas

Leading to: Crystal structures, metals, alloys, glass

Links to Physics: Matter

Links to Biology:

Good Stories:

Activity Description: This article discusses several common substances and their crystal structures. It would be a good article for students to read if your course includes a unit on solid structures. The article is followed by a student activity on crystal growing.

Number and Topic: **6. Chemical Names and Formulas/Compounds and Elements**
8. Chemical Reactions

Source: *ChemMatters*, Dec. 2000, pp. 4-6, "Hydrogen Fuel Cells for Future Cars"

Type of Material: Student Journal Article

Building on: Elements, Chemical Reactions

Leading to: Redox, Electrochemistry

Links to Physics:

Links to Biology: Ecosystems

Good Stories:

Activity Description: Article discusses the need for an alternative to the internal combustion engine and current research to develop cars that can utilize hydrogen fuel cells.

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Activity: Breakfast of Crystals
Activity: Buckyballs
Activity: Carbon Dioxide: A Pourable Greenhouse Gas
Activity: Iron for Breakfast
Activity: Making Ice Cream
Demo: Stoichiometry and Solubility - Mole Ratios and Chemical Formulas
Lab: Determining a Molecular Formula
Lab: Formula of a Blue Hydrate
Lab: Magnesium Oxide - Percent Composition and Empirical Formula
Lab: What is the Copper Formula?

ICE LABS

[Online Descriptions and Experiments](#)

Number and Topic: 6. Chemical Names and Formulas
Source: ICE Laboratory Leadership
Type of Material: Lab 5. What is the Copper Formula?
Building on: 8. Chemical reactions
Leading to: 7. Moles.
9. Stoichiometry.
13. Electrons in atoms.
Links to Physics: Structure of the atom
Links to Biology: Determining levels of trace elements in biological systems
Good Stories:
Activity Description: To determine experimentally the percent copper in a compound and to select the formula of that copper-containing compound from a list of possible formulas. All compounds have a definite composition in terms of the relative masses and the number of atoms of elements. However, the same elements may unite in different ratios. Compounds often can be identified by the relative amount of a particular element they contain. For example, by knowing the amount of copper that can be removed from a copper compound, the formula of the compound can be selected from a number of possible choices.

Number and Topic: 6. Chemical Names and Formulas
7. Moles.
Source: ICE Laboratory Leadership
Type of Material: Lab 6. Formula of a Blue Hydrate
Building on: 2. Measurement
Leading to: 9. Stoichiometry
Links to Physics: Energy
Links to Biology: Function of water in complex systems (?)
Good Stories:
Activity Description: To determine the formula of a blue hydrate. Hydrates have a variety of practical applications. Their ability to gain or lose their waters of hydration makes them versatile. One formula unit of a hydrate contains one formula unit of an anhydride bonded to a fixed number of water molecules. Careful heating removes the water so that the ratio of water molecules to anhydride formula units can be determined, provided the molar mass of the anhydride is known. A hydrate is represented by the formula of the anhydride followed by a raised dot that represents the "weak" bond between the anhydride and the number of water molecules, i.e. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

Number and Topic:	6. Chemical Names and Formulas, 7. Moles.
Source:	ICE Laboratory Leadership
Type of Material:	Lab 7. Determining a Molecular Formula
Building on:	8. Chemical reactions 12. Gases/Gas Laws/Kinetic theory
Leading to:	9. Stoichiometry
Links to Physics:	Gas behavior (?)
Links to Biology:	Analysis of complex molecules
Good Stories:	
Activity Description:	The molecular (true) formula for a substance is not always the same as its empirical (simplest) formula. Both acetylene and benzene have the empirical formula CH. However, the molar mass for acetylene is 26 g/mol, while the molar mass of benzene is 78 g/mol. This is because the molecular formula for acetylene is C ₂ H ₂ while the molecular formula for benzene is C ₆ H ₆ . To determine the molar mass of a gaseous substance and to use this value to find the molecular formula of the substance.

Technology-Adapted Labs

No activities for this topic.