# ARISE Curriculum Guide

# Chemistry: Topic 12—Gases/Gas Laws/Kinematic Theory

## ChemMatters

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### Articles for Student Use

Airbags: Chemical Reaction Saves Lives: Feb. 1997, pp. 4-5.
An Atomic Tour: Oct. 1983, pp. 4-7.
Carbon Dioxide: A Pourable Greenhouse Gas: Sep. 2001, pp. 10-11.
Cartesian Divers: Squeeze Play: Feb. 2001, pp. 4-6.
Do Ducks Get Cold Feet? Dec. 2001, p. 2.
The Exploding Tire: April 1988, pp. 12-14.
Hot Air Balloons, Gas and Go: April 2002, pp. 4-5.
Hydrogen Beer: Feb. 2002, p. 2.
The Lake Nyos Disaster: Feb. 1996, pp. 13-15.
Mt. Everest: Climbing in Thin Air: Feb. 2000, pp. 4-6.
Noisy Knuckles and Henry's Law: Dec. 2000, pp12-12.
Ozone: Molecule with a Split: Sep. 2001, pp. 7-9.
Popcorn: Oct. 1984, pp. 10-13.
Rockets: Chemistry Model for Liftoff: April 2001.
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Scuba: The Chemistry of an Adventure: Feb. 2001, pp. 7-9.
Try It! Make Your Own Hot Air Balloon: April 2002, p. 6.
Volcanoes-Forecasting the Fury: Dec. 1999, pp. 12-13.
Why do eggs take longer to cook in the mountains? Feb. 2000, p. 16.

### Articles for Teacher Use

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| Number and Topic: | 2. Measurement<br>12. Gases/Gas Laws/Kinetic Theory |
| Source: | *ChemMatters*, Feb. 2001, pp. 4-6, "Cartesian Divers: Squeeze Play" |
| Type of Material: | Student Journal Article and Activity |
| Building on: | Measurement, density |
| Leading to: | Archimedes' Principle |
| Links to Physics: | Motion and forces, gravity |
| Links to Biology: | Fish utilize swim bladders much like Cartesian Divers |
| Good Stories: | |
| Activity Description: | Article describes what Cartesian divers are as well as the principles that underlie their operation. Instructions are provided for students to build their own Cartesian divers. |

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| **Number and Topic:** | **4. Atomic Structure**<br>**6. Chemical Names and Formulas/Compounds and Elements**<br>**10. Phases, Solids, Liquids and Gases (States of Matter)**<br>**12. Gases/Gas Laws/Kinetic Theory**<br>**16. Covalent Bonds, Molecular Shapes and Intermolecular Forces**<br>**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. |

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| **Number and Topic:** | **5. Radioactivity, Fusion, Fission**<br>**8. Chemical Reactions**<br>**12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, Dec. 1999, pp. 12-13, "Volcanoes—Forecasting the Fury" |
| Type of Material: | Student Journal Article |
| Building on: | Gases, Radioactivity, chemical reactions |
| Leading to: | Viscosity, pH, acid rain |
| Links to Physics: | Heat, nuclear, radioisotopes |
| Links to Biology: | |
| Good Stories: | Relates the story of Mt. St. Helens explosion of 1980. |
| Activity Description: | Discusses volcanic eruptions, how and why they occur and their links to topics such as acid rain. |

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| **Number and Topic:** | **6. Chemical Names and Formulas/Compounds and Elements**<br>**8. Chemical Reactions**<br>**12. Gases/Gas Laws/Kinetic Theory**<br>**18. Reaction Rates and Kinetics and Kineticsand 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. |

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| **Number and Topic:** | **6. Chemical Names and Formulas/Compounds and Elements**<br>**8. Chemical Reactions**<br>**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. |

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| **Number and Topic:** | **8. Chemical Reactions**<br>**9. Stoichiometry**<br>**11. Thermochemistry**<br>**12. Gases/Gas Laws/Kinetic Theory**<br>**22. Redox/Electrochemistry/Electrochemistry** |
| Source: | *ChemMatters*, April 2001, "Rockets: Chemistry Model for Liftoff" |
| Type of Material: | Student Journal Article |
| Building on: | Properties of compounds and elements, chemical reactions, gas laws |
| Leading to: | Redox reactions |
| Links to Physics: | Strong links to motions and forces and kinematics as well as measurement |
| Links to Biology: | |
| Good Stories: | |
| Activity Description: | Article describes the basic principles behind the operation of a model rocket, both chemical and physical. |

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| **Number and Topic:** | **8. Chemical Reactions**<br>**12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, Feb. 1997, pp. 4-5, "Airbags: Chemical Reaction Saves Lives" |
| Type of Material: | Student Journal Article |
| Building on: | Chemical reactions, gases |
| Leading to: | Reaction rates |
| Links to Physics: | Motions and forces |
| Links to Biology: | |
| Good Stories: | Given the ubiquitous presence of airbags in modern automobiles, it is surprising to realize that the first crash between two automobiles equipped with airbags occurred in 1990. |
| Activity Description: | Article presents the history of the development of airbags and does a thorough job of explaining the chemical reactions and physical processes involved in their operation. |

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| **Number and Topic:** | **8. Chemical Reactions**<br>**9. Stoichiometry**<br>**12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, April 1988, pp. 12-14, "The Exploding Tire" |
| Type of Material: | Student Journal Article |
| Building on: | Gas laws, chemical reactions |
| Leading to: | Explosive mixtures |
| Links to Physics: | Gas laws |
| Links to Biology: | |
| Good Stories: | |
| Activity Description: | Article deals with a "mystery" explosion of a tire that was being repaired. It discusses how the use of a can of "instant flat tire fixer" was the cause of the explosion, and it goes into the specific chemical reactions involved as well as their stoichiometry. |

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| **Number and Topic:** | **10. Phases, Solids, Liquids and Gases (States of Matter)**<br>**12 Gases/Gas Laws/Kinetic Theory**<br>**17. Water, Aqueous Solutions** |
| Source: | *ChemMatters*, Feb. 2001, pp. 7-9, "Scuba: The Chemistry of an Adventure" |
| Type of Material: | Student Journal Article |
| Building on: | States of matter, density, gases, water |
| Leading to: | Heat capacity, refraction, Henry's Law |
| Links to Physics: | Refraction, motion and forces |
| Links to Biology: | Ecosystems |
| Good Stories: | Author relates her personal experiences while learning how to Scuba dive. |
| Activity Description: | Article relates the author's experiences while Scuba diving and then tries to explain the scientific reasons behind the phenomena, for example, why submerged objects appear to be closer or why colors fade. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, April 2002, pp. 4-5, "Hot Air Balloons, Gas and Go" |
| Type of Material: | Student Journal Article |
| Building on: | Gas behavior and Gas Laws |
| Leading to: | Archimedes' Principle |
| Links to Physics: | Motion and forces, gravity, heat |
| Links to Biology: | |
| Good Stories: | Good stories about early attempts to fly hot air balloons |
| Activity Description: | A good general treatment of hot air balloons, their history, and the scientific principles that underlie their operation. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, April 2002, p. 6, "Try It! Make Your Own Hot Air Balloon" |
| Type of Material: | Activity |
| Building on: | Gases/gas laws, kinetic theory |
| Leading to: | Can lead to advanced calculations related to Archimedes' Principle if desired. |
| Links to Physics: | Motion and Forces, Gravity, Heat |
| Links to Biology: | |
| Good Stories: | |
| Activity Description: | This 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. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory**<br>**17. Water, Aqueous Solutions** |
| Source: | *ChemMatters*, Feb. 2002, p. 2, "Hydrogen Beer" |
| Type of Material: | Student Journal Article |
| Building on: | Elements |
| Leading to: | Gases, solubility, Henry's Law |
| Links to Physics: | |
| Links to Biology: | |
| Good Stories: | The entire article is a great "story." |
| Activity Description: | Terrific story about "hydrogen beer," a beer said to contain hydrogen gas rather than carbon dioxide. Hydrogen beer is a hoax, an "urban legend" but was actually able to fool enough educated people so that it made it to a reputable physics Website as well as a chemistry textbook. Applying simple notions of solubility, etc., should have revealed its obvious nonvalidity. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, Dec. 2001, p. 2, "Do Ducks Get Cold Feet?" |
| Type of Material: | Student Journal Article |
| Building on: | Kinetic Theory |
| Leading to: | Example of a practical application of heat flow in nature |
| Links to Physics: | Energy, kinetic theory, heat |
| Links to Biology: | Animals, adaptations |
| Good Stories: | Interesting story of how a duck uses a clever arrangement of veins and arteries to prevent excessive heat loss through its feet when swimming in icy water Activity Description: Given the large surface area of a duck's feet, it would seem that they would lose an excessive, perhaps unrecoverable amount of heat when swimming in icy water. But through an ingenious arrangement of veins and arteries, they manage to keep heat loss to a minimum. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, Dec. 2000, pp. 12-12, "Noisy Knuckles and Henry's Law" |
| Type of Material: | Student Journal Article |
| Building on: | Gas laws, aqueous solutions |
| Leading to: | Henry's Law |
| Links to Physics: | |
| Links to Biology: | Structure of a knuckle joint |
| Good Stories: | |
| Activity Description: | Article describes the structure of the human knuckle and what happens when you "crack" a knuckle. It connects to both biology and to Henry's Law. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory**<br>**19. Equilibrium** |
| Source: | *ChemMatters*, Feb. 2000, pp. 4-6, "Mt. Everest: Climbing in Thin Air" |
| Type of Material: | Student Journal Article |
| Building on: | Gases |
| Leading to: | Dalton's Laws of Partial Pressure, Le Chatelier's Principle |
| Links to Physics: | Electromagnetic spectrum |
| Links to Biology: | Cells, respiration, hemoglobin |
| Good Stories: | Relates challenges involved in trying to scale Mt. Everest |
| Activity Description: | Discusses how atmospheric pressure changes with altitude and how this leads to a shortage of oxygen at high altitudes. This is then related to the great challenges that face any person attempting to climb Mt. Everest. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory**<br>**17. Water, Aqueous Solution**<br>**18. Reaction Rates and Kinetics** |
| Source: | *ChemMatters*, Feb. 2000, p. 16, "Why Do Eggs take Longer to Cook in the Mountains?" |
| Type of Material: | Student Journal Article including a fun quiz |
| Building on: | Gases |
| Leading to: | Colligative properties of solutions |
| Links to Physics: | Heat, energy |
| Links to Biology: | Coagulation of proteins |
| Good Stories: | There is a "fun" quiz at the end of the article. |
| Activity Description: | Article discusses how pressure varies with altitude and how this affects the boiling point of water, which in turn affects the time required to hard boil an egg. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory**<br>**17. Water, Aqueous Solutions** |
| Source: | *ChemMatters*, Feb. 1996, pp. 13-15, "The Lake Nyos Disaster" |
| Type of Material: | Student Journal Article |
| Building on: | Gases |
| Leading to: | Water, aqueous solutions |
| Links to Physics: | |
| Links to Biology: | |
| Good Stories: | On August 21, 1986, a cloud of carbon dioxide was released from Lake Nyos in Cameroon, West Africa, killing 1,724 people and several thousand animals. |
| Activity Description: | Article explains how carbon dioxide accumulated in Lake Nyos over a period of years, why it remained in the lake at high concentrations, and what probably caused it to be rapidly released, resulting in the disaster. |

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| **Number and Topic:** | **12. Gases/Gas Laws/Kinetic Theory** |
| Source: | *ChemMatters*, Oct. 1984, pp. 10-13, "Popcorn" |
| Type of Material: | Student Journal Article and Activity |
| Building on: | Personal experience with popcorn |
| Leading to: | Scientific principles that underlie its popping behavior |
| Links to Physics: | Gas laws |
| Links to Biology: | The structure of popcorn |
| Good Stories: | |
| Activity Description: | This article discusses the structure of popcorn and what results in its "popping" when heated. The article is followed by a student activity that investigates and even measures the percent moisture in a popcorn kernel. |

## Flinn ChemTopic Labs

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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 for this topic.

## Technology-Adapted Labs

No activities for this topic.