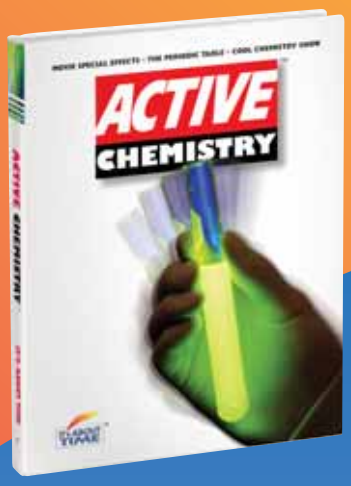
Active Chemistry™ Course Overview



- a proven guided-inquiry, project-based chemistry course that works with students of all learning levels
- an instructional approach that engages all students in the learning of chemistry

What Inquiry Should Be

IT's ABOUT TIME®
HERFF JONES EDUCATION DIVISION

Active Chemistry: It's about increasing student achievement.

Active Chemistry™ is developed using an instructional strategy that combines guided-inquiry and whole-class instruction with appropriate content. It's about increasing student achievement.

Active Chemistry is a research-based curriculum that has been field-tested in diverse classrooms for 3 years and has demonstrated increased student engagement and learning. It's about a proven approach.

Active Chemistry is a curriculum that weaves together all the activities and chapter content to build a strong grasp of the science concepts so that students can transfer their understanding to relevant real-world projects. It's about having more than just isolated activities and content.

Our Commitment to Research-Based Curricula.

Are all "research-based" programs equal? When we say research-based this is what we mean: Our developers created the chapters in *Active Chemistry* from the very conception on the best research on how students best learn and how teachers can best facilitate this process in the classroom. *Active Chemistry* relies on the rigorous research of the National Science Foundation development process. *Active Chemistry* consequently promotes positive student attitudes toward science and positive perceptions of the student as learner. It engages students through the use of real-world contexts and provides a deeper understanding of the role of science and technology in the workplace.

First Year of the Curriculum Development Process — Content Specialists, Master Teachers.

Under the direction of a distinguished, active, and dynamic Advisory Board (that meets twice yearly over a three-to four-year period), the program's Principal Investigators select and then oversee teams of writers chosen from top university science education departments, content-based science departments, specially selected high school teachers, and industry scientists to collaborate on the development of the first drafts of the curriculum materials. These lead authors, each a distinguished content specialist and/or educator from a leading university, also serve as part of the Review Committee to assess each other's works for pedagogical strategies and content accuracy.

The curriculum is then reviewed and evaluated by other leading educational specialists for pedagogy, content, safety, equity, readability, cognitive effectiveness, and efficacy, and then the curriculum is revised again based on those results.

All new materials proceed through the following system for development and revision:

- Approved by Content Review Committee comprised of leading content experts
- Approved by the following consultants: science educators, master teachers, and cognitive scientists
- Micro-tested by the development group. A micro-test is a series of tests of a few students with careful observation and follow-up interviews by the developers

Second Year of the Curriculum Development Process — Content Specialists Pilot to Ensure Curriculum is Correct and Rigorous.

The curriculum is then ready to be pilot tested by a select group of high school teachers from across the country. After an extensive summer training course, these teachers spend the next year piloting the program in their classrooms.

- Pilot tested by master teachers in their classrooms
- Pilot materials, classes, teachers, and students are studied and evaluated based on an established evaluation and research design model
- Materials are also reviewed by leading content experts and science educators to evaluate if the materials appropriately prepare students for their later study in these subjects
- Materials are then revised based on the pilot feedback, experts' reviews and evaluation and research reports

Third Year of the Curriculum Development Process — Diverse Classrooms to Ensure Approach is Appropriate for All Students.

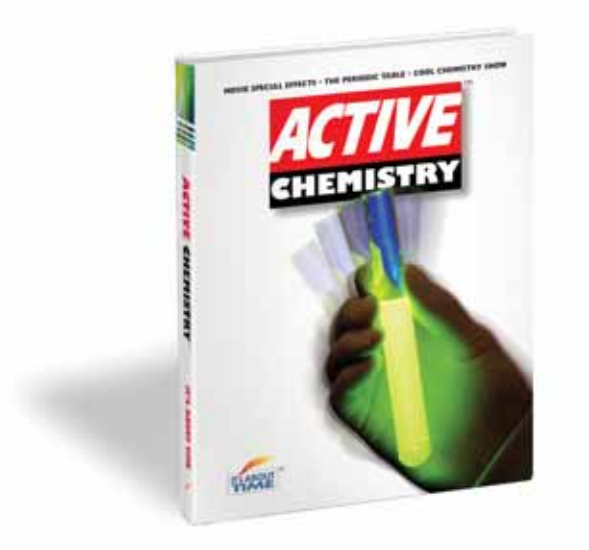
The curriculum is now ready to be field-tested by a broad range of high school teachers from across the country. After an extensive summer training course, these teachers spend the next year field-testing the materials in their classrooms.

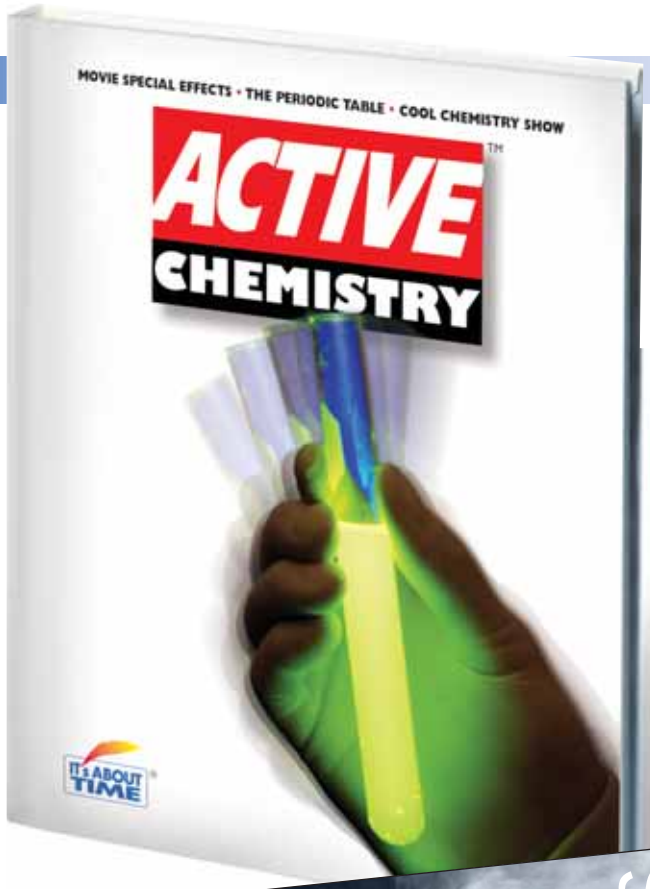
Like the pilot test, the research/evaluation component of the revision process is designed to inform the next iteration and revision of the materials.

- Field-testing of the materials conducted in a wide range of classrooms by teachers with a wide range of experience and expertise
- Field-test materials, classes, teachers, and students are studied and evaluated based on the evaluation and research design model
- Materials are then revised again based on the field-test feedback, experts' reviews and evaluation and research reports

Fourth Year of the Development Process.

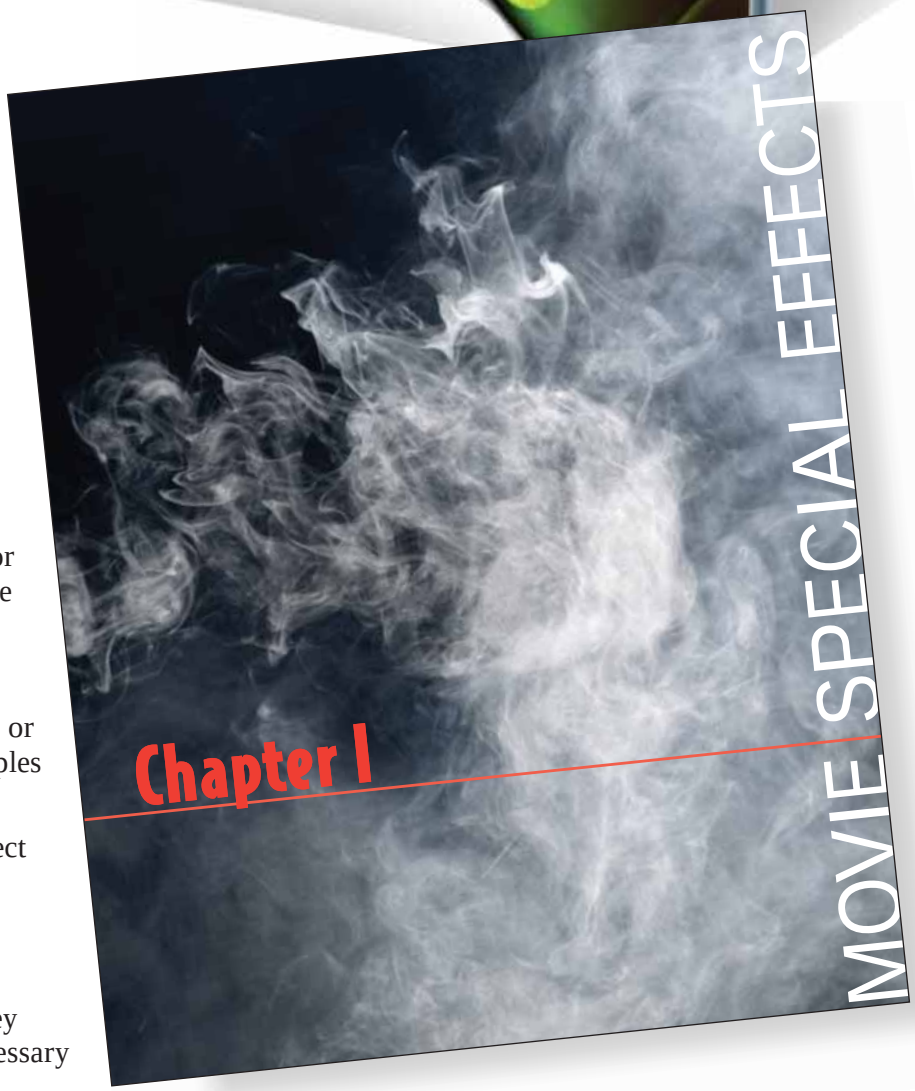
Additional consultant specialists in cognitive psychology, assessment, technology, science education and equity continue to be brought into the project to review the materials and secure its pedagogical approach and content basis. Finally, the product is turned over to the commercial publisher to mold into a commercial product.





Active Chemistry **contains all the chemistry content you need for teaching a true inquiry-based, Physical Science course. Developed to be used in conjunction with *Active Physics*, it is an excellent and innovative approach for implementing a successful standards-based physical science program. It has qualitative analysis, quantitative analysis, electrochemistry, thermochemistry, and kinetics as you would expect, but not where you would expect to find them. In a traditional chemistry course, you may teach dimension analysis in the fall, thermochemistry in the winter, and electrochemistry in the spring. In *Active Chemistry*, students are introduced to chemistry concepts on a need-to-know basis as they explore chapters like *Movie Special Effects*, *The Periodic Table*, and *Cool Chemistry Show*.**

Each chapter is independent of the others, allowing you to begin with the chapter that best suits your students' needs and interests.



For example, suppose you choose to begin with the *Movie Special Effects* chapter. On the first day your students are introduced to the Chapter Challenge. Your *Active Chemistry* class has been invited to participate in a low-budget movie. The students have been asked to write a script for a simple scene in which they can incorporate some special effects.

To meet their challenge, students must:

- Write a script that requires a special effect or effects using one or more chemical principles
- Provide a written procedure to the "producer" explaining how the special effect works
- Demonstrate the special effect using acceptable safety procedures

How can students get started? How can they complete such a challenge without the necessary chemistry knowledge? That's what makes

1

Movie Special Effects

Scenario

You have all been captivated and entertained by special effects in movies. The explosions, makeup, animation, and props in the "blockbuster" features take months and millions of dollars to put together. Many special effects are the result of the application of science and technology.

Your *Active Chemistry* class has been asked to participate in the production of a low-budget movie. However, to make the film exciting, the movie producer would still like to use some awesome special effects. You are being asked to write a simple scene in which you can incorporate some special effects. Of course, in addition to cost, safety is also a m concern.

Chapter Challenge

Your challenge is to create a story line and produce sp effects based on the chemistry you have learned in yo *Active Chemistry* class. You will need to demonstrate special effects you created. Your special effects will b evaluated on their quality, interest, entertainment, ar knowledge of chemistry you exhibited in putting the together.

You will need to complete the following tasks:
- Write a script for a simple scene in a movie.
- Choose a special effect to include as part of you
- Write a procedure on how your special effect is
- Demonstrate the special effect to the "producer
- Write an explanation of how the special effect including the chemistry behind the demonstrati

Using more than one chemical principle will strengthen your presentation.

SE2

Criteria

How will your special effect be graded? What qualities should an effective special effect have? How will your demonstration and supporting documentation be graded? Discuss these issues in small groups and with your class. You may decide that some or all of the following qualities should be graded:

- Demonstration
- Safety
- Quality
- Interest and appeal to audience
- Supporting documentation
- Script – creativity
  - Procedure – clarity, safety, accuracy
  - Chemistry explanation – accuracy and quantity of chemical principles incorporated

Once you have determined the list of qualities for evaluating the documentation and demonstration, you and your class should also decide how many points should be given for each criterion. How many points should be assigned to the documentation and how many to the demonstration? Should more points go to the chemistry explanation than to the movie script? How many different chemical principles should be incorporated in your special effect? Determining grading criteria might be a time-consuming task, but knowing the point values in advance will help you focus your time and effort on the most important aspects of your special-effect documentation and demonstration.

Will each student produce his/her own special effect, will students be required to work in groups, or will both options be offered? Discuss the pros and cons of these possibilities. Keep in mind that if you are going to be working in groups, it is important to discuss before the work begins how each member of the group will be graded. Determine grading criteria that reward each individual in the group for his/her contribution and also reward the group for the final project. You should discuss different strategies and choose the one that is best suited to your situation. Make sure that you understand all the criteria as well as you can before you begin. Your teacher may provide you with a sample rubric to help you get started.

SE3

Active Chemistry unique. Students are introduced to chemistry they can use to complete the challenge on a need-to-know basis.

Before the chapter activities begin, a discussion takes place about the Criteria for success. The class discusses what is expected in an excellent presentation and how it will be graded. For instance, they may decide that the rubric for grading will include the following factors:

- the accuracy of the explanation of the chemical principles used in the special effect
- the creativity of the script
- the interest and appeal to the audience
- safety considerations
- the quality of the demonstration.

They also need to decide whether each factor carries equal weight, or if one has a greater impact. Students will have a sense of what is required for an excellent presentation before they begin. They will revisit the criteria before work on the challenge is finalized.

The second day begins with the first of nine activities. As one activity is completed, the next one starts. *Active Chemistry* is an activity-based curriculum.

Active Chemistry Movie Special Effects

Activity 1 Elements and Compounds

GOALS

In this activity you will:

- Separate water by electrolysis into the two elements from which it is composed.
- Test the two elements to determine their identities.
- Learn one way to determine the chemical formula of a material.
- Compare characteristic properties of a material to those of its constituent elements.
- Represent materials with chemical formulas using numbers and the symbols of elements.
- Practice safe laboratory techniques with flames and explosions.

What Do You Think?

Matter is the name for all the "stuff" in the universe. Anything that has mass and occupies space is called matter.

- How many kinds of matter are there in the universe: 1, 10, 100, 1000, 10,000, or more than 10,000?
- What makes up matter?

Record your ideas in your *Active Chemistry* log. Be prepared to discuss your responses with your small group and the class.

Investigate

1. Look around your classroom at the kinds of matter that make up the things you can see.
   a) Make a list of 10 kinds of materials that make up the objects you see. For example, you might list the wood that makes up your pencil, or the glass that makes the windows.
   b) To understand the nature of matter, it helps to know if it is simple or complex. Is it made from only one kind of material or is it a mixture of various materials? Classify each of the 10 materials you listed as pure or mixtures.

SE 4

For example, look at Activity 1: Elements and Compounds. Students begin by considering what matter is and how many kinds of matter there might be in the universe. These What Do You Think? questions are intended to find out what students know about elements and compounds. Formally, you can say that these questions elicit the students' prior understanding and is part of the constructivist approach. Students write a response for one minute and discuss for another two minutes. But you don't try to reach closure. The question opens the conversation.

Students then begin the Investigate section of the activity. In the Investigate section they are involved in

ChemTalk

THE STRUCTURE OF MATTER

In this investigation you used electricity to separate water into two gases. You knew that the gases were different because they reacted differently to the burning and glowing splints. Since water is referred to as H_2O, a first guess would be that hydrogen (H) and oxygen (O) were created in the experiment. The test for hydrogen is a small explosion when exposed to a burning splint. The test for oxygen is igniting a glowing splint. If you look back on the results of the experiment, you find that the hydrogen gas filled one test tube while the oxygen filled half of the other test tube. There was twice as much hydrogen as oxygen. That's where the "2" comes from in the chemical formula H_2O.

Hydrogen and oxygen are elements. An **element** is any material that cannot be broken down into simpler materials. You are probably familiar with many elements like hydrogen, oxygen, zinc, gold, or helium. Other elements like strontium and beryllium are more exotic and less likely to be familiar to you. Every kind of matter you observe in your everyday life is made up of the chemical elements. There are only about a hundred different kinds of chemical elements. This is an amazing discovery of chemistry – everything you observe in the world is made of different combinations of a hundred elements. Chemistry is the study of how these elements combine and the characteristics of these combinations.

Chem Words

element: any material that cannot be broken down into simpler materials (composed of only one kind of atom).

a number of activities that teach them chemical content, laboratory skills, and safety procedures. They separate water by electrolysis into the two elements from which it is composed and test the two elements to determine their identities. They can then conclude that the compound water is made up of two elements: hydrogen and oxygen. They have also experienced the differences in properties between the compound, water, and its constituent elements.

ChemTalk summarizes the chemistry principles and includes chemical formulas and equations where appropriate. It also presents students with text,

Active Chemistry Movie Special Effects

From the table of chemical formulas, you can see that carbon dioxide is a compound of carbon and oxygen. There are two atoms of oxygen for every atom of carbon. Sodium hydrogen carbonate (sodium bicarbonate) is a compound of sodium, hydrogen, carbon, and oxygen. There are three atoms of oxygen for every atom of the other elements. Also, there are a total of three atoms in the carbon dioxide formula and a total of six atoms in sodium hydrogen carbonate.

To generate the gas to fill the empty eggshell in this activity (the teacher demonstration), zinc was placed in hydrochloric acid. Zinc is an element. Hydrochloric acid (HCl) is a compound of hydrogen and chlorine. The reaction of the zinc and hydrochloric acid created a gas. Given the explosion you observed, you can guess that the gas produced was hydrogen. The hydrogen gas came from the hydrogen in the hydrochloric acid.

There's much more to the structure of matter than you can discover in just one activity. However, this activity may have raised some new questions in your mind. For example:

- Can all compounds be separated into their elements?
- What techniques can be used to separate compounds?
- What are elements made of?
- What are atoms?
- What are molecules?

These questions and many more will be explored in other *Active Chemistry* activities.

Checking Up

1. In your own words, explain the difference between an element and a compound.
2. Why are symbols useful in describing chemical elements?
3. What are the symbols for the following elements: carbon, copper, gold, and helium?
4. What information does a chemical formula of a compound provide?

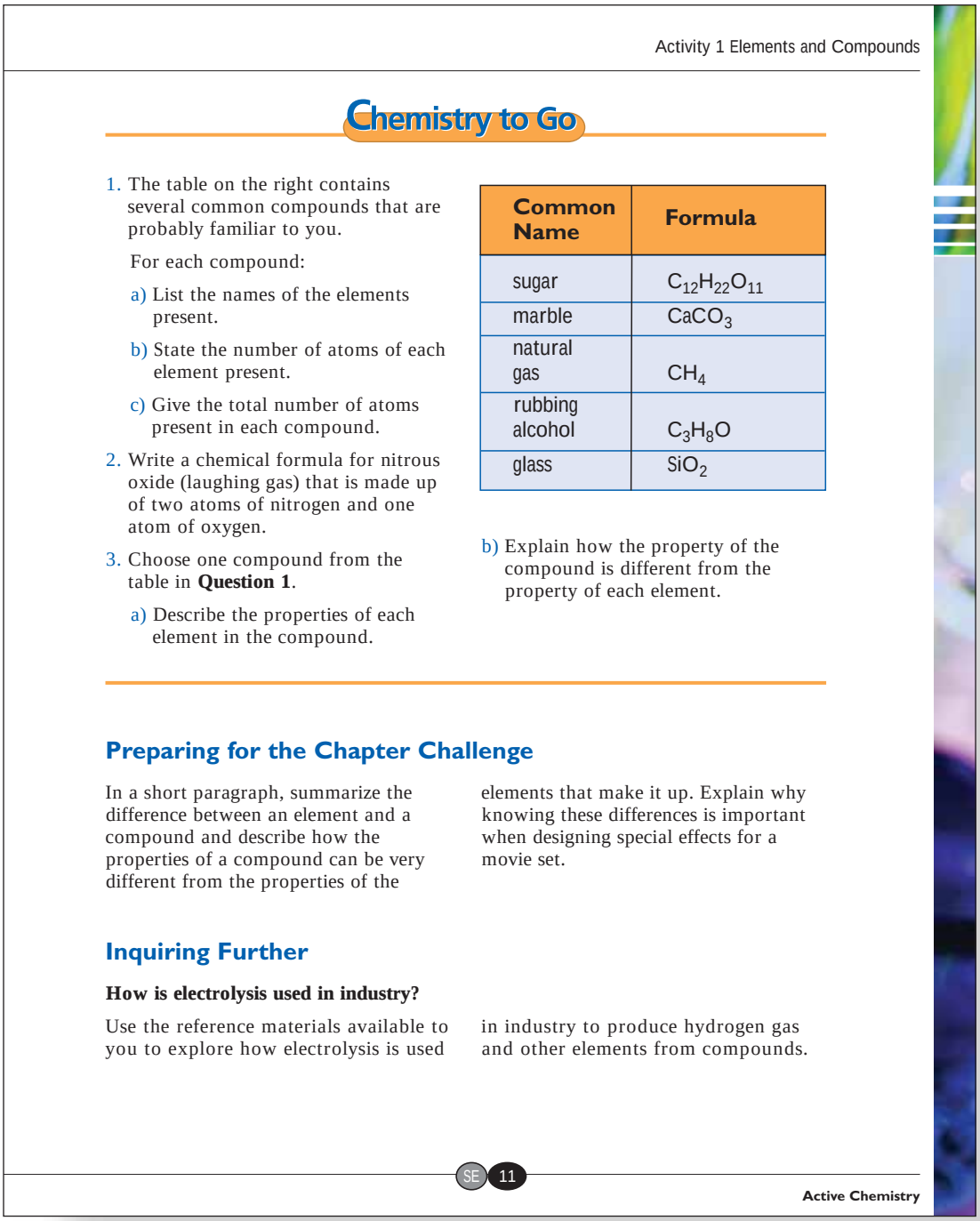
Reflecting on the Activity and the Challenge

Part of the problem you are facing in creating a special effect is understanding what matter is made of and how it can change. In this activity you broke a chemical compound down into its component elements using electrolysis. In another part of the activity a compound was made from chemical elements through a fast and noisy reaction. There are only about one hundred elements, but there are many thousand compounds. You should begin thinking of ways in which some of the reactions you observe could be made to appear more dramatic on screen, without making them any larger in real life. You can now use the concepts of elements and compounds to provide the chemistry description of what is occurring.

illustrations, and photographs that provide greater insight into the chemistry concepts presented. Words that may be new or unfamiliar to the students are highlighted. To provide reading support, they are also defined and explained outside the text area in Chem Words. In addition to this, Checking Up includes questions designed to guide student reading.

Reflecting on the Activity and the Challenge provides a brief summary of the activity and relates the activity to the larger challenge of developing a special effect for their movie scene. The activity has provided students one more link in understanding the principles of chemical and physical reactions and how they can be used in their demonstration.

The activity continues with a Chemistry to Go homework assignment. Here, students are asked about



Chemistry to Go

1. The table on the right contains several common compounds that are probably familiar to you.

   For each compound:

   a) List the names of the elements present.

   b) State the number of atoms of each element present.

   c) Give the total number of atoms present in each compound.

2. Write a chemical formula for nitrous oxide (laughing gas) that is made up of two atoms of nitrogen and one atom of oxygen.

3. Choose one compound from the table in **Question 1**.

   a) Describe the properties of each element in the compound.

Common Name	Formula
sugar	$C_{12}H_{22}O_{11}$
marble	$CaCO_3$
natural gas	CH_4
rubbing alcohol	C_3H_8O
glass	SiO_2

   b) Explain how the property of the compound is different from the property of each element.

Preparing for the Chapter Challenge

In a short paragraph, summarize the difference between an element and a compound and describe how the properties of a compound can be very different from the properties of the elements that make it up. Explain why knowing these differences is important when designing special effects for a movie set.

Inquiring Further

How is electrolysis used in industry?

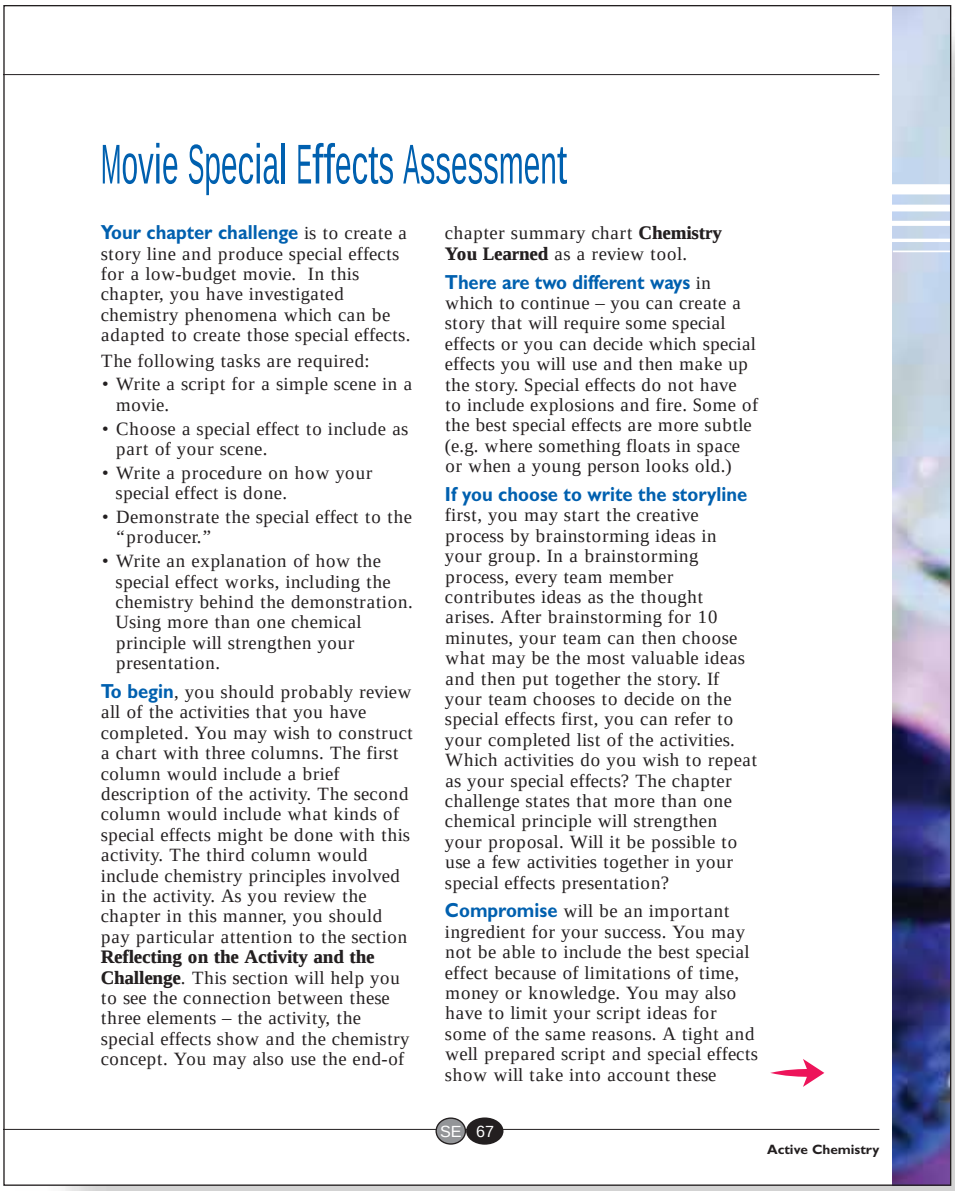
Use the reference materials available to you to explore how electrolysis is used in industry to produce hydrogen gas and other elements from compounds.

the specifics of the activity and are required to write chemical formulas for various compounds.

Preparing for the Chapter Challenge provides students with suggestions of ways to organize their work to get ready for the challenge. It prompts them to combine the results of their inquiry as they work through the chapter.

Inquiring Further: This feature provides many suggestions for deepening your students understanding of the concepts and skills developed in the activity. It also gives them an opportunity to relate what they have learned to the Earth system.

With the results of all of the activities before them, student teams now are able to complete the challenge.



Movie Special Effects Assessment

Your chapter challenge is to create a story line and produce special effects for a low-budget movie. In this chapter, you have investigated chemistry phenomena which can be adapted to create those special effects.

The following tasks are required:

- Write a script for a simple scene in a movie.
- Choose a special effect to include as part of your scene.
- Write a procedure on how your special effect is done.
- Demonstrate the special effect to the "producer."
- Write an explanation of how the special effect works, including the chemistry behind the demonstration. Using more than one chemical principle will strengthen your presentation.

To begin, you should probably review all of the activities that you have completed. You may wish to construct a chart with three columns. The first column would include a brief description of the activity. The second column would include what kinds of special effects might be done with this activity. The third column would include chemistry principles involved in the activity. As you review the chapter in this manner, you should pay particular attention to the section **Reflecting on the Activity and the Challenge**. This section will help you to see the connection between these three elements – the activity, the special effects show and the chemistry concept. You may also use the end-of chapter summary chart **Chemistry You Learned** as a review tool.

There are two different ways in which to continue – you can create a story that will require some special effects or you can decide which special effects you will use and then make up the story. Special effects do not have to include explosions and fire. Some of the best special effects are more subtle (e.g. where something floats in space or when a young person looks old.)

If you choose to write the storyline first, you may start the creative process by brainstorming ideas in your group. In a brainstorming process, every team member contributes ideas as the thought arises. After brainstorming for 10 minutes, your team can then choose what may be the most valuable ideas and then put together the story. If your team chooses to decide on the special effects first, you can refer to your completed list of the activities. Which activities do you wish to repeat as your special effects? The chapter challenge states that more than one chemical principle will strengthen your proposal. Will it be possible to use a few activities together in your special effects presentation?

Compromise will be an important ingredient for your success. You may not be able to include the best special effect because of limitations of time, money or knowledge. You may also have to limit your script ideas for some of the same reasons. A tight and well prepared script and special effects show will take into account these

The Chapter Assessment also guides students to the activities that they can review.

The teams share their work with the rest of the class and the *Movie Special Effects* chapter concludes. One strength of *Active Chemistry* is the independence of the chapters. After finishing *Movie Special Effects,* they begin anew.

You may now decide to go to *The Periodic Table* chapter that will allow your students to develop a variety of different types of games to explain how the periodic table is used. In this chapter the students are challenged to learn the chemical and physical properties of the elements of the periodic table and how they can use this knowledge to produce some type of game for the class to use. The students not only learn the physical and chemical properties of the elements, they will have fun with their fellow students in designing clever and creative games.

The text concludes with a Chemistry at Work profile where students are introduced to a special effects expert who uses chemistry at work.

Chemistry at Work

Marc Pollack

President, Flix FX

"Everyone talks about 'Movie Magic,'" says Marc Pollack, president of the prestigious Hollywood special effects company Flix FX. "So I guess that makes me a magician." But Pollack is clearly more comedian than magician. The 'magic' he creates for movies like *Blackhawk Down*, *Men In Black* and *Cast Away*, in addition to scores of television commercials, museum installments and Las Vegas casinos, is the product not of mysterious hocus-pocus but rather fundamental principles of science. "One of the most important aspects of our work," he continues, "is to push the limits of how chemicals are designed to be used." Among other things, Pollack and his crew at Flix FX use vacuum-forming thermo-plastics to make tin-based silicon molds for everything from prehistoric creatures to futuristic robots. Through a combination of trial and error experimentation and traditional research science, they've perfected the process. "Silicon is what we call an R.T.V.," Pollack explains. "That stands for room temperature vulcanization. So depending on the type and amount of catalyst we use, the mold will cure at different rates and with slightly differing properties." By manipulating the ratio of silicon to catalysts they can make strong, realistic molds in the most efficient way possible. "Increasing the amount of catalyst will speed up the curing process but too much catalyst will shorten the life of the mold," he says. "Every job is different so determining that balance is one of our many challenges."

Pollack, who is now a master in the art of using chemicals like silicon, polypropylene, urethane and urethane elastimers, is not a chemist by trade. He actually graduated from film school at SUNY Purchase in the hopes of becoming "the next Steven Spielberg." Then, through a twist of fate, he became a special effects nut and eventually founded Flix FX in 1990. "Now," Pollack says, "Spielberg may one day come to me."

Special effects – Pollack creates both mechanical and physical – is an industry in a constant state of transformation. "The industry is always trying new stuff and that's exciting," Pollack says. "For instance, someone just developed a great water-based breakaway glass for stunts called Smash Glass. It's similar to fiberglass without the dangerous elements associated with that material and can be made to break into either large chunks or tiny little pieces. I can't wait to get my hands on it and break it over someone's head. That's part of my job these days and I love it."

Active Chemistry has many advantages:

- Flexible — Since each chapter is independent of one another it provides a great deal of flexibility and multiple opportunities for your students to be successful.
- Student-Friendly Chemistry — Students do not need high levels of math and reading to be successful. Students learn important chemistry concepts by doing chemistry. Students know that they have a real-life challenge and that the activities will help them achieve their goal.
- Engaging — Themes that are relevant to students' lives. Students in *Active Chemistry* never ask, "Why am I learning this?" Teachers of *Active Chemistry* never have to respond, "Because one day it will be useful to you." *Active Chemistry* is relevant chemistry.

Active Chemistry is just what you have been looking for to help you to meet your state frameworks, as well as the National Science Education Standards.

ACTIVE CHEMISTRY AND THE NATIONAL SCIENCE EDUCATION STANDARDS

Active Chemistry Chapter	Movie Special Effects	The Periodic Table	Cool Chemistry Show
Physical Science			
Structure of Atoms	•	•	•
Structure and properties of matter	•	•	•
Chemical reactions	•	•	•
Motions and forces	•	•	
Conservation of energy and increase in disorder	•	•	•
Interactions of energy and matter	•	•	
Unifying Concepts and Processes			
Systems, order and organization	•	•	•
Evidence, models and explanations	•	•	
Constancy, change and measurement	•	•	•
Evolution and equilibrium	•		•
Form and function	•		•
Science as Inquiry			
Identify questions and concepts that guide scientific investigations	•	•	•
Design and conduct scientific investigations	•	•	•
Use technology and mathematics to improve investigations	•	•	•
Formulate and revise scientific explanations and models using logic and evidence	•	•	•
Communicate and defend a scientific argument	•	•	•
Understand scientific inquiry	•	•	•
Science and Technology			
Identify a problem or design an opportunity	•	•	•
Propose designs and choose between alternate solutions	•	•	
Implement a proposed solution	•		
Evaluate the solutions and their consequences	•		•
Communicate the problem, process, and solution	•	•	•
Understand science and technology	•	•	•
Science in Personal and Social Perspectives			
Personal and community health	•		
Population growth			
Natural resources	•		
Environmental quality			
Natural and human induced hazards			
Science and technology in local, national, and global challenges	•		
History and Nature of Science			
Science as a human endeavor	•	•	•
Nature of scientific knowledge	•	•	•
Historical perspectives	•	•	•

Movie Special Effects

Activity Summaries — Chemistry Principles

Chapter Challenge

The movie producer has asked your class to produce a movie scene using special effects that involve chemistry concepts. The students will develop a script for the scene that they are producing and will provide an explanation of the chemistry concepts that they used to produce the special effect.

Activity One: Elements and Compounds

The activity discusses the basic concept of what is matter and how we can dissociate compounds back to the elements. Also, students will conduct some simple tests to identify hydrogen and oxygen gas.

- Electrolysis
- Chemical reaction
- Chemical elements
- Compounds
- Chemical properties

Activity Two: States of Matter: Solid, Liquid, and Gas

This activity helps the students develop an understanding of molecular motion in the different physical states: solid, liquid, and gas.

- Heating curves
- Kinetic energy
- Potential energy
- Physical states of matter
- Molecular motion
- Sublimation

Activity Three: Solutions, Suspensions, and Colloids

This activity shows the students how to differentiate between solutions, suspensions, and colloids. The mixtures are tested for the Tyndall Effect and if they can be separated by simple filtration.

- Tyndall effect
- Filtration
- Homogeneous mixture
- Heterogeneous mixture

Activity Four: Properties of Matter

This activity helps the students understand how small models can be used to represent large structures. Models can be used to develop an understanding of the physical properties of a substance.

- Physical Properties
- Composites
- Emulsions

Activity Five: Mass and Volume

The students will determine the density of liquids and solids. The solids will be irregular shaped, so that water displacement techniques need to be used to determine the densities.

- Density
- Displacement
- Measurements

Activity Six: Metals and Nonmetals

This activity will study the physical properties of metals and will show how they can be differentiated from the nonmetals. They will also learn how the metals, metalloids, and nonmetals are arranged on the periodic table.

- Metallic properties
- Metalloids
- Nonmetals
- Alloys

Activity Seven: Polymers

This activity shows the students how to make the polymer “slime” and how to test this non-Newtonian liquid. They will find that it has both solid and liquid characteristics.

- Polymers
- Cross-linked polymers
- Commercial uses of polymers

Activity Eight: Identifying Matter

This activity uses the flame tests to help identify metal cations. The principles of fireworks are discussed and how these metals can be used to produce the different colors.

- Metal visible colored flame
- Electron excitation

Activity Nine: Organic Substances

The students will learn what the term organic means to scientists and how the layman uses it incorrectly. They will study how ethylene gas is used in ripening fruit and some chemical properties of the alkenes.

- Hydrocarbon
- Alkanes
- Alkenes
- Alkynes
- Organic compounds

The Periodic Table

Activity Summaries	Chemistry Principles

Chapter Challenge

As we study the properties of the elements, we are able to categorize the elements. The students will learn how *Mendeleev* was able to arrange the elements according to the chemical behavior that was known at his time. The challenge is for the students to develop some type of game that can be used to teach others how to learn and use the periodic table. These games are left up to the creativity of the students. Card, computer, or board games are some choices that they may decide on using.

Activity One: Organizing a Store

Students learn how to organize a store by categorizing the different items that are contained in the store and where new items are placed.

- Periodicity
- Trends

Activity Two: Elements and Their Properties

Students determine some of the physical and chemical properties of elements and start the process of arranging the chemicals into families.

- Atoms
- Physical properties
- Chemical properties
- Conductivity
- Reactivity

Activity Three: Atoms and Their Masses

Why we believe in atoms is the first hurdle that the early scientists had to overcome. In this activity the students show why they believe in atoms and how the elements of different atoms interact with each other.

- Atomic mass
- Single-displacement reaction
- Law of Definite Proportions
- Quantitative analysis
- Measurements
- Mole

Activity Four: Are Atoms Indivisible?

This activity shows the students that an atom consists of protons and electrons. It also suggests where these particles are located in the atom.

- Cathode rays
- Properties of electrons
- Location of proton
- Nucleus
- Dalton's Atomic Theory

Activity Five: The Chemical Behavior of Atoms

This activity leads the students into the understanding of the energy of an electron and how it may be arranged about the nucleus of the atom. Spectroscopic analysis is used to determine the excited levels that an electron can occupy.

- Hydrogen's line spectrum
- Frequency
- Wavelengths
- Energy of wavelengths
- Bohr's Atomic Model
- Light waves
- Spectroscopic analysis

Activity Six: Atoms with More than One Electron

This activity continues the investigation of the excitation of electrons in different atoms. The ionization energy of the elements are used to learn how the electrons are arranged and configured for each different atom.

- Element line spectrum
- Ionization energy
- Electron configuration
- Period
- Ion

Activity Seven: How Electrons Determine Chemical Behavior

This activity shows that each family of the periodic table has its own unique electron configuration. It also shows what energy levels are occupied.

- Electron configuration
- Noble gases
- Valence electrons
- Chemical families

Activity Eight: How Atoms Interact With Each Other

This activity explains why atoms combine in certain proportions by transferring electrons from one atom to another. The difference between ionic and covalent bonds is also explained.

- Octet rule
- Ionic bonds
- Covalent bonds
- Chemical formulas
- Binary compounds

Activity Nine: What Determines and Limits an Atom's Mass?

The mass of an atom is determined by the sum of its protons and neutrons. Since almost all elements have isotopes the mass listed in the periodic table is then called the average atomic mass. This activity also shows that the number of elements is limited to the stability of the nucleus. This nuclear stability is dependent upon the number of neutrons and protons contained in the nucleus.

- Atomic mass
- Isotopes
- Nucleons
- Radioactivity
- Binding energy
- Electrostatic forces
- Strong nuclear force
- Nuclear fission
- Nuclear fusion

Cool Chemistry Show

Activity Summaries	Chemistry Principles

Chapter Challenge

One of the best ways to demonstrate that you understand the chemical concepts that you have studied is to be required to teach them to others. The challenge in the Cool Chemistry Show chapter is to have the students demonstrate chemistry concepts to grade school children. They not only demonstrate, but also have to be able to explain and answer questions on the concept they are presenting.

Activity One: Chemical and Physical Changes This activity explains the difference between chemical and physical changes. They are able to show what properties are necessary to have a chemical change.	• Chemical change • Physical change • Chemical reaction
Activity Two: More Chemical Changes This activity helps to identify the special properties of a chemical change or chemical reaction.	• Chemical tests • Acid-Base indicators • Precipitates
Activity Three: Chemical Names and Formulas This activity focuses on the element's symbol and how they can combine with each other to make compounds. The students also learn how to write the correct formulas of these compounds.	• Chemical symbols • Chemical formulas • Chemical compounds • Chemical names
Activity Four: Chemical Equations This activity introduces the students to single-and double-displacement reactions. Also, some simple tests to identify the products that are formed.	• Chemical equations • Balancing chemical equations • Single-displacement reactions • Double-displacement reactions • Synthesis • Decomposition • Metal-activity series • Solubility rules
Activity Five: Chemical Energy This activity requires the students to determine what type of reactions produce heat. They will discover that both physical and chemical changes produce heat.	• Heat energy • Endothermic reactions • Exothermic reactions • Conservation of Energy
Activity Six: Reaction Rates This activity reviews some of the properties that affect the rate of a chemical reaction. Concentration, temperature, nature of the compound, and the use of catalysts are examined in different chemical reactions.	• Reaction rates • Concentration • Kinetic energy • Collision theory • Catalysts
Activity Seven: Acids, Bases, and Indicators – Colorful Chemistry This activity discusses the properties of acids and bases. Students will also learn how to use an indicator to determine the acidity of a solution.	• Acids/Bases • Arrhenius acids and bases • Indicators • pH • Titration • Neutralization
Activity Eight: Color Reactions That Involve the Transfer of Electrons This activity is used to determine the pH and also what the pH scale is. It also looks at different indicators and what pH range they change color. This activity involves oxidation and reduction reactions between metals. The activity of metals is used to determine which metals will react. Metal plating out and color changes of solutions are evidence of chemical reactions taking place.	• Oxidation • Reduction • Galvanization • Metal plating • Rust

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