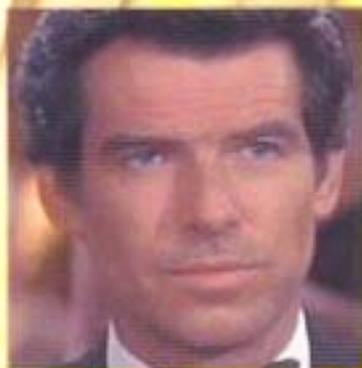


PREPARE TO BE SHAKEN AND STIRRED!

THE NAME'S BOND ...

... CHEMICAL BOND



IT'S THE REASON:

- That Diamonds are Forever
- There is a Goldfinger
- A Man with a Golden Gun could have a Golden Eye

ALSO IN THIS ISSUE:

WHO WILL BE THE WEAKEST LINK?

- Can Ion Nick stand alone?
- Will Co Valent become stronger by bonding with others?
- Ms. Metallic fears she needs to change, or it's GOOD BYE!



AN INTEGRATED, INTERDISCIPLINARY, THEMATIC STUDY OF
CHEMICAL BONDING FOR THE HIGH SCHOOL LEVEL

Joyce Abel, Patrick Downing, Theresa Pizzuti, and Sharon Owens

Richland Northeast High School
7500 Brookfield Road
Columbia, South Carolina 29223

Unit Title:
Prepare to be Shaken and Stirred!
The Name's Bond....Chemical Bond

OVERVIEW

I. **CONTENT:** (Why is this unit important: What are the essential concepts in this unit?)
The students will learn the differences between ionic, covalent, and metallic bonds and how they relate to observed properties of compounds. They will also learn the formation, structure, properties, uses and typical chemical reactions of common inorganic/organic compounds.

II. **PROCESS:** (How are the thinking skills developed?)
The students will compare covalent, ionic and metallic bonding and relate bonding to observed properties of compounds. They will discuss the formation, structure, properties, uses and typical reactions of common inorganic compounds. They will conduct laboratory experiments that will allow them to apply what they learn.

III. **PRODUCT:** (What will kids do/know as a result of this unit?)
The students will be able to use the periodic table to infer the number of valence electrons in an atom and describe the formation of cations and anions. They will list the characteristics of ionic bonds and use the characteristics to explain the properties. They will use the theory of metallic bonds to explain the physical properties of metals.

**Unit Overview: Alignment with
State/District Pupil Performance Outcomes**

GOAL 1: Given a formula, students will identify the elements present and the number of atoms of each element.

GOAL 2: Students will use oxidation numbers to write formulas.

GOAL 3: Students will name and write formulas for binary and ternary compounds.

GOAL 4: Students will identify balanced chemical equations and their type of reaction.

GOAL 5: Students will state how the Law of Conservation of Mass relates to balanced equations.

**I-SEARCH INDEPENDENT RESEARCH PROJECTS
FOR GIFTED AND TALENTED STUDENTS**

1. PARADOXES:

Mathematical or mental constructs such as electron clouds represent something solid. When solid models are used to illustrate atomic scale events, it is possible to produce this misconception among students that solid models and pictures resemble solids, when in fact, it may not.

Product: Design a model to illustrate chemical bonding in which the atoms are not represented as being solid.

2. ATTRIBUTES:

Read the article "What's in an Inkblot? Some Say, Not Much" by Erica Goode. On the Internet, go to the "Take a Rorschach Test" web site.

Product: Create a mobile in which you have selected 5 scientists from this unit of study who have contributed to the concept of chemical bonding. Paste a drawing/picture of the scientist on one side and using traditional and/or original drawings, paste Rorschach inkblots on the other side of the mobile that correspond to the personality of the scientist.

3. ANALOGIES:

The actual form of a molecule having resonance structures is like a central party in politics, a moderate denomination in religion or mixing red and blue paint. Research one of the analogies mentioned with the concept of resonance.

Product: Design a story board that illustrates this concept.

4. DISCREPANCIES:

A 1997 Seattle Times' investigation found that, across the nation, industrial wastes laden with heavy metals and other toxic substances are being used in fertilizers and spread over farmland. The process, which is legal, saves industries the high costs of disposing of hazardous wastes. Watch the movie Erin Brockovich.

Product: Write a petition, in which as a parent of a child in a rural farming community, you feel there is a link between the chemical dumping on a neighbor's farm and the neuro-physiological problems appearing in your child.

5. PROVOCATIVE QUESTIONS:

Imagine a plastic so "smart" that it can be used to sense a baby's breath, measure the force of a karate punch, sense the presence of a person 100 feet away, or make a balloon that sings.

Product: Design an informational pamphlet for this plastic film for the general public which will make the high costs involved in processing seem a small price to pay for its near-magical properties.

6. EXAMPLES OF CHANGE:

Aromatherapy is currently a popular fad. However, it is known that people respond to different odors and that these odors can affect mood.

Product: Create a display that traces the development and formulation of perfumes correlated with significant historical events.

7. EXAMPLES OF HABIT:

Sing aloud the following nursery rhyme. "Twinkle, twinkle little star. How I wonder what you are. Up above the world so high. Like a diamond in the sky. . ." Research the constellation Centaurus with its spectrum of light similar to a diamond's fire.

Product: Write a science fiction story to answer the following questions: 1) What if man's grasp of the Universe has limited our expectations of "what is actually out there?" 2) What if there really are diamonds in the sky?

8. ORGANIZED RANDOM SEARCH:

Research Gothic architecture of French, English, Italian, and German churches and cathedrals.

Product: Create transparency overlays that illustrate how the basic skeleton design of the cathedral is assigned a precisely defined role within the architectural framework, much like the precise geometry arrangements that create stable molecules of atoms and electrons.

9. SKILLS OF SEARCH:

Research and print out the following Periodic Table examples: spiral, circle, pyramid and rectangle. Find the Internet site by Earth/Matrix: Science Today.

Product: Set up a database which details why each historical Periodic Table is arranged in a particular manner. Compare in chart form the new schemata of the elements, shown on the Earth/Matrix website to the conventional tables. Devise an experimental situation to test the success of this new Periodic Table version in a high school setting. Then carry out this experiment and report on your findings.

10. TOLERANCE FOR AMBIGUITY:

Watch excerpts from Contact, Men in Black, Independence Day, Close Encounters of the Third Kind, and ET. Listen to an excerpt from The War of the Worlds available from waxfiles or read from the novel written by H. G. Wells. Ponder the question, "What does the ending say about the control humans have over life?"

Product: In an editorial essay, address the fear/hope felt by the general public when new drugs with somewhat drastic side-effects are developed to combat life-threatening diseases.

11. INTUITIVE EXPRESSION:

Some basic scientific research has no foreseeable practical value other than “Knowledge for knowledge’s sake.” Many medical, scientific and technological breakthroughs were made possible only because knowledge was gained by prior basic research.

Product: You are the CEO of a pharmaceutical company and are about to testify before a congressional panel your reasons for ending the funding in the development of a drug that will be used in the treatment of only a few thousand patients a year. In your testimony you will address the issue: “Does industry bear a responsibility to support basic research?”

12. ADJUSTMENT TO DEVELOPMENT:

In the movie, Field of Dreams, Kevin Costner is told “If you build it, they will come.” In nanotechnology, the question is, “If you build it, will it move?”

Product: Design a flip book that illustrates a “Magic School Bus Ride” through the body as a nanomolecule designed to find a cancer cell and neutralize it in the uterus or prostate.

13. STUDY CREATIVE PEOPLE AND PROCESS:

Watch 10 movies or television shows that in some way discusses or features science and scientific inquiry. Read the articles “Lene Vestergaard Hau: She Puts the Brakes on Light” by Malcolm W. Brown and “Scientists Seek a New Movie Role Hero, Not Villain” by Andrew Pollack. List all the descriptive words or phrases used to describe a scientist and his accomplishments.

Product: Develop the elements of a new television series on chemistry. Devise the general storyline. The show must present scientists in a different light than how the entertainment media typically presents them. The main character must be either a woman or other minority.

14. EVALUATE SITUATIONS:

Research/report on why solid iron is used instead of ferrous iron to fortify cereals.

Product: Interview a medical doctor who can explain the hazards associated with using ferrous irons in cereals, especially for small children. Or, write a letter to the cereal company for product information.

15. CREATIVE READING SKILL:

Read P. W. Atkin’s book, “The Periodic Kingdom: A Journey Into the Land of the Chemical Elements.”

Product: Review the book at a press conference and critique the analogy between a kingdom and the periodic table created by the author.

16. CREATIVE LISTENING SKILL:

Listen to the songs “Back Together Again” (Roberta Flack), “Make or Break” (The Firm), or “The Flame” (Fine Young Cannibals).

Product: Develop a dance or dramatization illustrating the type of chemical bonding portrayed.

17. CREATIVE WRITING SKILL:

Read the poem “Yuck” by Shel Silverstein. Research/hypothesize about the substance “Yuck.”

Product: Write a second stanza to the poem answering the question: “What is “Yuck?” Illustrate your stanza.

18. VISUALIZATION SKILL:

The bonding concept is difficult to explain to a student with limited English proficiency.

Product: Using works by modern artists in the mediums of painting, sculpture or photography, create a photo essay that illustrates all of the bonding types.

**CRITICAL THINKING SKILLS – ACADEMIC
ANALYZING HUMAN ACTIVITIES! (AHA!)**

STATE STANDARD # IV.B.3.a-c.

STUDENTS WILL BE ABLE TO:

- a) Trace the history development of matter by contributions of Lavoisier, Dalton, etc.
- b) Compare and contrast elements and compound
- c) Classify compounds as being crystalline solids (ionic) or molecules (covalent) based on the transfer or sharing of outer electrons.

ESSENTIAL QUESTION: How does the Universal Theme of **Producing, Exchanging and Distributing** create mastery learning of essential concepts in this unit?

1. **PRODUCING, EXCHANGING, AND DISTRIBUTING** [ECONOMICS]

KNOWLEDGE:

Anticipatory Set: Video Clip from Flubber

Students will: Describe in their own words the substance flubber and be able to recognize the formation of a chemical compound.

COMPREHENSION:

The student will be able to distinguish between an ionic and a covalent compound by their individual properties.

APPLICATION:

Anticipatory Set: Ionic/Covalent Compounds Lab

Students will: Create a product that the substance, flubber, could be used for and write an ad campaign to market that product

Class/team product: Demonstration of the ad campaign.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Write an ad directed at a specific market group: teenagers, Senior citizens, etc.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

List the chemical and physical properties of flubber. Did you include any of them in your ad?

SCHOOL-TO-CAREER/TECH PREP LINK:

Interview the business/career teacher. What are some things that you need to consider before marketing a substance?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Students will show their advertisements of their product.

Students will: Poll 20 people to see if they will use this product.

Class/team/individual product: Assign a price to the product and justify the cost.

INDIVIDUAL JOURNAL ASSIGNMENT:

Suppose you were asked to create a product using flubber in athletic shoes for one of the NBA teams before the play-offs. Decide if you would make the shoes and defend your decision.

HOMELINK:

Talk with parents about the phrase, “What’s in a name?” Is there a reason that your parents gave you your name?

STATE STANDARD # IV.B.4.a.

STUDENTS WILL BE ABLE TO:

Relate the physical properties of compounds to their type of bonding.

ESSENTIAL QUESTION: How does the Universal Theme of **Transportation** create mastery learning of essential in this unit?

2. **TRANSPORTATION**

KNOWLEDGE:

Anticipatory Set: Cartoon “All Star Exterminators” by Gary Larson.

Students will: Be able to discuss the proper handling and labeling of hazardous materials.

COMPREHENSION:

Students will be able to predict when two elements are in close proximity whether electrons will be transferred from one atom to another in order to form a compound.

APPLICATION:

Anticipatory Set: Video clip of Gladiator.

Students will: Imagine that they were transported back to the Middle Ages into the arena as a Gladiator. They will be able to bring only one compound synthesized in the 20th or 21st Century with them. From research of several products, students will select their product to take with them.

Class/team product: Sketch a scene or perform a dramatization using this material as a means of survival. Correct applications of the substance’s properties must be used.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Purchase both an English and foreign language edition of a magazine. List the newly developed products shown in both editions.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Compare the cost of the products in both editions of the magazine.

SCHOOL-TO-CAREER/TECH PREP LINK:

Which market audiences are the products being marketed for?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory set: Clip from Back to the Future.

Students will: Evaluate the following situation: Suppose the Federal Government, in the year 2050, had decided that nonessential use of plastic is a crime. Any person found using or possessing nonessential plastics will be subject to a fine along with confiscation of the material. Your bedroom is due to be inspected by the Plastic Police in one hour. Identify the plastic items in your bedroom and justify those you will keep.

Class/team/individual product: Oral presentations to the class on the justification of plastic items kept.

INDIVIDUAL JOURNAL ASSIGNMENT:

Research the chemical composition of gasoline. Why do manufacturers have different formulas in different climates and seasons?

HOMELINK:

Select 10 items in your home. Construct “Thinking Maps (Venn Diagrams) that detail/trace the path each item takes from “birth” to its arrival in your home.

STATE STANDARD # **IV.B.3.c.,d.**

STUDENTS WILL BE ABLE TO: Identify compounds and their molecular shapes.

ESSENTIAL QUESTION: How does the Universal Theme of **Communications** create mastery learning of essential concepts in this unit?

3. COMMUNICATIONS

KNOWLEDGE:

Anticipatory Set: Songs “Ions Mine” or “Student Rap”

Students will: Be able to list and define any words or phrases that are new to them or unfamiliar to the average nonscientist.

COMPREHENSION:

Students will be able to name and write common formulas.

APPLICATION:

Anticipatory Set: Slides of familiar classical paintings.

Students will: Be able to prepare one pigment color from the lab, “Artist’s Paints”, and design on poster paper using their prepared color, a painting for the most probable chemical reaction that produced their color of pigment.

Class/team product: Arrange paintings around the walls of the classroom to create a mural.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Explain the significance of a chemical formula to someone is not proficient in the English language.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Translate a chemical equation into a sentence. Given a sentence, translate it into a chemical equation. Show mathematically how you know if an equation is balanced correctly.

SCHOOL-TO-CAREER/TECH PREP LINK:

What are your future plans? In what ways has this class helped? How could it have helped more?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Demonstration by the teacher on the ancient art of Origami (Japanese paper folding)

Students will: Be able to construct a tetrahedral carbon atom and use this to relate the tetrahedral shape to other organic compounds.

Class/team/individual product: Combine tetrahedral shapes to make one giant molecule.

INDIVIDUAL JOURNAL ASSIGNMENT:

Students will write about the one molecular shape that best describes them and give reasons for their choice.

HOMELINK:

Examine a coat rack in either your home or a friend’s home. Compare a carbon atom with its four electrons to a coat rack with its four hooks. Draw a detailed illustration of both and diagram the correct areas that have similar functions.

STATE STANDARD # IV.B.4.a.

STUDENTS WILL BE ABLE TO:

Relate the physical properties of compounds to their type of bonding.

ESSENTIAL QUESTION: How does the Universal Theme of **Protecting and Conserving** create mastery learning of essential concepts in this unit?

4. **PROTECTING AND CONSERVING**

KNOWLEDGE:

Anticipatory Set: Environmental film clip of a landfill

Students will: Be able to deduce 10 problems with overcrowded landfills.

COMPREHENSION:

Students will role-play the members of a community for a town meeting where the pros and cons of placing a new landfill in their neighborhood will be discussed.

APPLICATION:

Anticipatory Set: Packages of different brands of disposable diapers

Students will: Be able to identify the different kinds of material found and describe the key properties of each.

Class/team product: Compare the absorbency of different brands.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

List all of the environmental organizations operating in a country of your choice. Are these same organizations operating in the United States?

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Research the role that the Environmental Protection Agency and other environmental organizations play in approving organic solvents for home use.

SCHOOL-TO-CAREER/TECH PREP LINK: What is the process for determining whether or not products should be approved? Who makes these types of decisions and on what basis are they made? Create a presentation in which you share your findings to the class.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: CNN Report

Student will: Be able to hypothesize as to the type of chemical bonding contributing to the distinctive properties of the disposable diaper. The student will construct a diagram of the cross-section of the diaper and explain the order of the material making up the diaper from inner layer to outer.

Class/team/individual product: Display of the construction of a disposable diaper with detailed illustrations and labels of composite parts.

INDIVIDUAL JOURNAL ASSIGNMENT:

Write a letter to your legislator supporting your position on a landfill to be built in your community.

HOMELINK:

Write a Rule of Thumb (ROT), which designers/manufacturers of products should keep in mind when consumers need to dispose of their products after use.

STATE STANDARD # IV.C.3.a.4.5.

STUDENTS WILL BE ABLE TO:

- a) Explain how acid rain is formed and discuss its effects on the environment
- b) Evaluate the role pH plays in the development of consumer products

ESSENTIAL QUESTION: How does the Universal Theme of **Providing Education** create mastery learning of essential concepts in this unit?

5. PROVIDING EDUCATION

KNOWLEDGE:

Anticipatory Set: Demonstration by the teacher of calcite and acid rain

Students will: Be able to describe the reaction in their own words.

COMPREHENSION:

After listening to the song, "Purple Rain," students will explain which chemical processes would have to occur in order to make the rain purple.

APPLICATION:

Anticipatory Set: Video clips of various TV commercials

Students will: Construct a pop-up book or photo essay on their favorite subject or topic and label the chemical compounds found in these products

Class/team product: Compilation into a book of chemical compounds.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Survey your home for products containing organic solvents. Make a record for how many of each type of solvent was found.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

After reporting findings back to the class, work with fellow classmates to create a master graph of the results. Identify the most common household products containing solvents. Were more of the products found intended for kitchen, yard, or another type of use?

SCHOOL-TO-CAREER/TECH PREP LINK:

What are the career requirements to be an organic chemist? Where do most organic chemists find employment?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Training video for Human Resources Departments

Students will: Hold their own interviews regarding the occurrence and causes of acid rain in this country.

Class/team/individual: Students will answer the question: Is there a connection between either smokestack emissions or car exhaust and the occurrence of acid rain?

INDIVIDUAL JOURNAL ASSIGNMENT:

Research and write on the restoration of the Statue of Liberty.

HOMELINK:

Visit a chemical plant or laboratory in your area. How does the work there impact your community as a whole?

STATE STANDARD # I.B.2.-6. and II.B.2.a.-d.

STUDENTS WILL BE ABLE TO:

- Select and use appropriate instruments to make the observations necessary for the investigation, taking into consideration the limitations of the equipment
- Identify technologies that could enhance the collection of data
- Select the appropriate safety equipment needed to conduct an investigation
- Suggest safety precautions that need to be implemented for the handling of materials and equipment used in an investigation
- Describe the proper response to emergency situations in the laboratory

ESSENTIAL QUESTIONS: How does the Universal Theme of **Making and Using Tools and/or Technology** create mastery learning of essential concepts in this unit?

6. MAKING AND USING TOOLS AND/OR TECHNOLOGY

KNOWLEDGE:

Anticipatory Set:

Article “Preserving the Past” in chemistry text.

Lab Safety Video

Students will: Identify the tools needed by a museum curator to determine if a gold coin is really 2000 years old. (be able to identify the tools found in their chemistry laboratory).

COMPREHENSION:

Students will choose a tool from their lab drawer or cabinet to create an advertisement or comic strip to demonstrate lab safety practices.

APPLICATION:

Anticipatory Set: Video clip from Indiana Jones and the Temple of Doom

Students will: Be able to defend the statement, “Chemistry’s Rosetta Stone is the Periodic Table and Law.”

Class/team product: Creation of a Rosetta Stone for a chemical reaction.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Research and report on other reasons for the need to be able to translate something into a common language.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Examine other historical writing that has been translated into modern language.

SCHOOL-TO-CAREER/TECH PREP LINK:

Why have so many “translations” been published for computer programming/usages manuals?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Excerpts from the book, Timeline, by Michael Crichton on the prototypes of the time machine.

Students will: Be able to write a science fiction chapter in which their design for a prototype of a new tool could be used in a laboratory of a manufacturer that produces cars that can fly.

Class/team/individual product: Compilation of the chapters into a book.

INDIVIDUAL JOURNAL ASSIGNMENT:

Students will recall a recent visit to a museum and write about an exhibit they have seen that deals with technology and/or chemistry.

HOMELINK:

Go to the Interactive websites designated by your teacher. Prepare an oral defense in favor of virtual field trips as opposed to traditional ones.

STATE STANDARD # IV.B.2.a.-d.

STUDENTS WILL BE ABLE TO

- Trace the historical development of the periodic table including the contributions of Mendeleev
- Explain the arrangement of elements within a group on the periodic table based on similar physical and chemical properties
- Explain the property trends on the periodic table are a function of the elements’ atomic structures

- d) Determine atomic number, mass number, number of protons, number of neutrons, and number of electrons for given isotopes of elements

ESSENTIAL QUESTION: How does the Universal Theme of **Providing Recreation** create mastery learning of essential concepts?

7. **PROVIDING RECREATION**

KNOWLEDGE:

Anticipatory Set: Gold plated test tube as a prize.

Students will: Go on a scavenger hunt around their houses or neighborhoods and keep a record of the elements they find.

COMPREHENSION:

Students will make a record in the form of a map of their houses or neighborhoods and then play a game with a fellow classmate. The students will be instructed to put X's on their maps where they found examples of their element lists. They will then see if their classmates can find the same elements they did.

APPLICATION:

Students will: Carry a Ziploc Baggie with instructions and ingredients for making either

Anticipatory Set: Two current Nike or sports advertisements from TV a hot or cold pack to the track. After students walk around the track for 10 – 15 minutes, they create a hot/cold pack and determine which one will relieve their aches faster.

Class/team product: Chart illustrating “cold” versus “hot” results.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

After researching the topic, compare the hot/cold packs that you made to hot/cold packs used by Olympic athletes.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Write an essay that compares the purpose of the original Olympic Games to modern day Olympic Games.

SCHOOL-TO-CAREER/TECH PREP LINK:

What were the ingredients/components in the first mass-produced hot/cold packs?

HIGHER ORDER THINKING SKILLS (H.O.T.S.)

Anticipatory Set:

National Geographic articles

Internet sites (ACS, PBS, etc.)

Video clip from What Women Want

Students will: Research the chemical process of odors and fragrance productions.

Class/team/individual: Conduct a mock trial of a date-rape case in which “drugs” were employed by both parties. The man in the case used Ecstasy to alter the behavior of his date. The woman in the case wore perfume with a natural pheromone component that had the ability to stimulate the production of a natural aphrodisiac in the man. The class will be divided into two teams, one in support of the man and one in support of the woman.

INDIVIDUAL JOURNAL ASSIGNMENT:

Students will write a newspaper article with an eye-catching headline about the date-rape mock trial.

HOMELINK:

Bring in substances from home so that fellow classmates can try to identify them in “Identification” Lab. Discuss the mock date-rape trial with family members.

STATE STANDARD # IV.C.2.d.3.

STUDENTS WILL BE ABLE TO:

Conclude from experimental evidence that mass is neither created nor destroyed, based on mass measurements.

ESSENTIAL QUESTION: How does the Universal Theme of **Organizing and Governing** create mastery learning of essential concepts in this unit?

8. **ORGANIZING AND GOVERNING**

KNOWLEDGE:

Anticipatory Set: Display of several Periodic Tables

Students will: Identify the differences in the arrangements of elements amongst the various Periodic Tables.

COMPREHENSION:

The students will be given a set of data cards of 20 elements and organize them in another system of classification other than the use of atomic number and mass. A team of students will then compare their means of classification.

APPLICATION:

Anticipatory Set: Internet websites on the Periodic Table that are interactive.

Students will: Research one element and create an element trading card to be duplicated 5 times in order to play an element trading card game.

Class/team product: Report on results of the game. Winners must have 5 different trading cards.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Research and report on why some elements' symbols do not match the first letter(s) of their names.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Student familiarity with the "indirect" proof in geometry.

SCHOOL-TO-CAREER/TECH PREP LINK:

Identify the careers that resulted from the discovery of new elements.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set:

Lucretius poem, "The Persistence of Atoms" (ca. 60 BC

James Clerk Maxwell lecture, "Molecules" (published in *Nature* 1873)

Students will: Answer the following question: Does Maxwell in his lecture on molecules, support the prime doctrine of classical physics that matter can neither be created nor destroyed first asserted many years earlier by Lucretius in his epic poem on atoms?

Class/team/individual product: Socratic discussion

INDIVIDUAL JOURNAL ASSIGNMENT:

After reading the excerpt from *The Periodic Table* (1975) on "Carbon," written by Primo Levi, the student will write a new scientific law for the element Carbon.

HOMELINK:

Write a letter to your chemistry lab partner convincing him/her to follow safety rules in a laboratory environment.

STATE STANDARD # _____

STUDENTS WILL BE ABLE TO _____.

ESSENTIAL QUESTION: How does the Universal Theme of **Moral, Ethical and Spiritual Behavior** create mastery learning of essential concepts in this unit?

9. **MORAL, ETHICAL, AND SPIRITUAL BEHAVIOR**

KNOWLEDGE:

Anticipatory Set: Video clip from Clan of the Cave Bear or Quest for Fire

Students will: Relate instances of ancient beliefs and practices in the worship of thunder and lightning.

COMPREHENSION:

In Ivan Turgenev's novel, *Father and Sons* (1861), the hero in the novel who is a self-proclaimed nihilist whose only value is scientific truth. On one occasion, when defending his views, the hero Barzarov, proclaims: "A decent chemist is twenty times more useful than any poet." The student will defend his viewpoint through the drawing of a political cartoon or the writing of a newspaper article

APPLICATION:

Anticipatory Set: Slide of selections from the *San Shi Liu* written in the 6th century AD. Internet websites.

Students will: Note the detailed instructions for making electrochemical cells and steps for the manufacture of gunpowder. The student will write a soliloquy that makes the comparison between what information is available to the public on the Internet and what was available in this ancient text.

Class/team product: Performance of the soliloquies.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Translate "The Chemist's Creed" into another language or rewrite the creed into simpler terminology so that an elementary school-age child can understand the meaning.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Is there a code of honor for mathematicians? Research another code of honor from history.

SCHOOL-TO-CAREER/TECH PREP LINK:

How is "The Chemist's Creed" similar to the "Hippocratic Oath" adhered to by the medical profession?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set:

Speaker from the nearby military base or National Guard

Internet websites on chemical warfare

Students will: Construct a segment for a timeline that traces the history of chemical warfare.

Class/team/individual product: Tape/glue the timelines together and place them along a school hallway for dramatic impact.

INDIVIDUAL JOURNAL ASSIGNMENT:

You are an artist from the Middle Ages and have been transported to the future, only to find out the materials that you used in your art creations are now being used in chemical warfare. How would you defend your need for these materials?

HOMELINK:

The song, "Kryptonite" sung by 3 Doors Down, contains in its title, the word "kryptonite." This substance is based on the fictional tale of a "super" chemical that is used to overcome a "superman." What is another "super" chemical that is being used today?

STATE STANDARD # I.C.1.2.

STUDENTS WILL BE ABLE TO:

Select and use appropriate technologies and b) discriminate between data that may be valid or anomalous.

ESSENTIAL QUESTION: How does the Universal Theme of **Aesthetic Needs** create mastery learning of essential concepts in this unit?

10. AESTHETIC NEEDS

KNOWLEDGE:

Anticipatory Set: Article, “Chance Favors the Prepared Mind: The Discovery of Scotch guard.”

Students will: Compile a list of articles in their home or car that use stain protective coatings.

COMPREHENSION:

Students will find illustrations of items on their list and make a collage.

APPLICATION:

Anticipatory Set: Articles or videos on the history of dyes.

Students will: Dye a T-shirt with a personally chosen color tint based on the historical premise that the color of the dye used in clothing indicated the work profession or social class of the individual.

Class/team product: The wearing of the T-shirt on a designated day.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Do some cultural or geographic regions prefer certain colors of house paints?

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Do different house paints for different building materials/compositions have different chemical formulations?

SCHOOL-TO-CAREER/TECH PREP LINK:

Suppose you work in a refinery and your boss informs you that facial hair and contact lenses could present a problem if you are around fumes or require respiratory protection. What will you do since you wear contact lenses and have a beard that your girlfriend loves?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Video clip from the opening credits in an episode of Baywatch

Students will: Investigate the nature of silicon. They are told until recently, plastic surgeons used silicon-filled implants for breast enlargement and other procedures and that intensive research is now underway to understand the effects of silicon on the human body. Students will summarize some of the contradictory results of recent research.

Class/team/individual product: Oral defenses if such implants should be banned.

INDIVIDUAL JOURNAL ASSIGNMENT:

You are the parent of a 16 year-old daughter/son. Write a few paragraphs defending your point of view on why she/he should not get a tattoo.

HOMELINK:

Survey 10 of your friends or family members. How many used a chemical process to change something about them?

STATE STANDARD # I.E.1.2.

STUDENTS WILL BE ABLE TO:

a) Compare current scientific models with experimental results

b) Select and defend, based on scientific criteria, the most plausible explanation or model

ESSENTIAL QUESTION: How does the discipline/sub-discipline of nomenclature relate to mastery learning of chemical bonding?

11. SOCIAL SCIENCE OR NOMENCLATURE

KNOWLEDGE:

Anticipatory Set: Oral reading of an element Biopoem.

Student will: Identify the element that is the subject of the Biopoem

COMPREHENSION:

Students will use the format of the Biopoem and compose a Biopoem about another chemical element.

APPLICATION:

Anticipatory Set: The *Element Song*

Student will: Play Element Bingo

Class/team product: Develop a “new” game based on the Periodic Table.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Identify the terms in this unit that have a connection to another language

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Identify the terms used in both your math and science textbook.

SCHOOL-TO-CAREER/TECH PREP LINK:

Find words used in the job descriptions of scientists, doctors, nurses, or engineers that have connections to the science field.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Students will take an imaginary tour of Mendeleev’s “Element Castle”.

Students will: Write a story or create a family tree for a family of elements. Major roles or contributions of each member of the family should be a component.

Class/team/individual product: After taking the imaginary tour of the “Element Castle”, students will design new rooms and develop clues to assist in the identification of the elements in the rooms.

INDIVIDUAL JOURNAL ASSIGNMENT:

Biologists who name newly discovered organisms use a system that is structured very much like the ones used by chemists in naming compounds/ The system used by biologists is called the Linnaeus system, after its' creator, Carolus Linnaeus. Research this system in a biology textbook, and then note similarities and differences between the Linnaeus system and chemical nomenclature.

HOMELINK:

Personify an atom of an element by writing a first-person narrative from the atom’s perspective about its location in the Periodic Table.

STATE STANDARD # IV.B.3.d.

STUDENTS WILL BE ABLE TO:

Predict the ratio by which the representative elements combine to form ionic compounds expressing that ratio in a chemical formula

ESSENTIAL QUESTION: How does the discipline/sub-discipline of oxidation numbers relate to mastery learning of chemical bonding?

12. MATHEMATICS OR OXIDATION NUMBERS

KNOWLEDGE:

Anticipatory Set: Laboratory test for Iron (II) and Iron (III) Ions.

Students will: Confirm the presence of the iron (III) ion.

COMPREHENSION:

After reviewing the common reactions of Group I metals in the *Elements Handbook*, the students will be able to address the following:

- Write the formulas for Group I metals that form super oxides.
- What is the charge on each cation for the formulas you wrote in (a)?
- How does the charge on the oxide anion vary for oxides, peroxides, and super oxides?

APPLICATION:

Anticipatory Set: Song by David Alan Coe, “You Don’t Have to Call Me Darlin” played during an overhead demonstration on molecular bonding.

Students will: Make electron dot structures using the bingo chips and cut-out element symbols for the first 18 elements and then for a series of molecules.

Class/team product: Electron dot structures displayed on desktops.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Write the names of five of the transition metals that have more than one oxidation number in a language other than English.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Why are Roman Numerals used in writing the names of some transition metals?

SCHOOL-TO-CAREER/TECH PREP LINK:

Report on the professionals that use oxides, peroxides and super oxides on a daily basis.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set:

Color transparencies depicting selected elements.

Transparency of the Aufbau Diagram

Students will: Be able to identify the elements described in the following fashion (e.g., electron configuration = $1s^2 2s^2 2p^6 3s^2 3p^4$; contains a full second energy level; contains the first d electron; contains seven electrons in the fourth energy level; contains only 2 electrons in the fifth energy level; etc.)

Class/team/individual product: Create a crossword puzzle using clues similar to the examples listed in the preceding statement.

INDIVIDUAL JOURNAL ASSIGNMENT:

After reading the article, “The Chemical Adventures of Sherlock Holmes: The Hound of Henry Armitage,” define the word “volatile” as it refers to chemistry. Compare your definition with the actual definition in a dictionary of science.

HOMELINK:

Read a Sherlock Holmes story of your choosing. Describe an experiment that Holmes performed that illustrated his knowledge of chemistry.

STATE STANDARD # IV.C.2.a.b.

STUDENTS WILL BE ABLE TO:

- a) Investigate and provide evidence of a chemical change by recording systematic observations for various chemical reactions
- b) Recognize balanced chemical equations
- c) Balance and write a net ionic equation

ESSENTIAL QUESTION: How does the discipline/sub-discipline of chemical equations and reactions relate to mastery learning of chemical bonding?

13. SCIENCES OR CHEMICAL REACTIONS AND EQUATIONS

KNOWLEDGE:

Anticipatory Set: Series of teacher performed demonstrations for each of the 5 main types of chemical reactions.

Students will: Identify the different types of chemical reactions.

COMPREHENSION:

After diagramming a skeletal equation, the student will be able to write and balance chemical equations.

APPLICATION:

Anticipatory Set: Qualitative lab.

Students will: Confirm the identity of 8 unknown solutions.

Class/team product: Set up a logic matrix to identify the unknown solutions.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Create a guide to understanding a chemical reaction for younger children in your native/second language.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Offer a mathematical explanation of how valence electrons are involved in bonding.

SCHOOL-TO-CAREER/TECH PREP LINK:

Balance a set of chemical equations from local industrial processes.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Single Displacement Reaction Lab

Students will: Design a set of experiments that will enable them to create an activity series for the elements comprising the following metals and solutions:

- a) aluminum and aluminum chloride
- b) chromium and chromium (III) chloride
- c) iron and iron (II) chloride
- d) magnesium and magnesium chloride

Class/team product: Write equations for chemical reactions that occur in local industrial processes.

INDIVIDUAL JOURNAL ASSIGNMENT:

Compose a song or poem about your favorite chemical reaction (PG-13 only please!)

HOMELINK:

Compare the recipe for an alloy to the recipe for a food product.

STATE STANDARD # I.B.2,4,9,10

STUDENTS WILL BE ABLE TO:

- a) Select and use appropriate instruments to make the observations necessary for the investigation, taking into consideration the limitations of the equipment

- b) Select the appropriate safety equipment needed to conduct an investigation (e.g., goggles, aprons, etc.)
- c) Organize and display data in useable and efficient formats, such as tables, graphs, maps, and cross sections
- d) Draw conclusions based on qualitative and quantitative data

ESSENTIAL QUESTION: How does the discipline/sub-discipline of ionic bonding and compounds relate to mastery learning of chemical bonding?

14. READING OR HUMANITIES/LITERATURE OR IONIC BONDING/COMPOUNDS

KNOWLEDGE:

Anticipatory Set: Teacher demo of “seeding” supersaturated solutions.

Students will: Identify 10 common substances in and around their home and be able to indicate whether they expect these substances to contain ionic, covalent, or metallic bonds.

COMPREHENSION:

Students will grow ionic crystals of sodium chloride (NaCl), alum (KAl(SO₄)₂), Epsom salts (MgSO₄), or copper (II) sulfate (CuSO₄).

APPLICATION:

Anticipatory Set:

Current shampoo commercial

Wigs or head mannequins borrowed from cosmetology

Students will: Use ion exchange resin to soften water

Class/team product: Chart comparison on how effective different shampoos cleaning hair or laboratory equipment.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Find shampoo ads that are written in a language other than English.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Create a graph that compares the cost-effectiveness of various shampoos.

SCHOOL-TO-CAREER/TECH PREP LINK:

Which career/profession uses water softeners?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Display of ornaments used to decorate a ring stand and utility clamps.

Students will: Be given 3 solutions that will be used to etch an ornament. Students will create a design on the ornament and then use the solutions for etching. Students will have to write and balance the complete reactions used in the laboratory process.

Class/team/individual product: Etched ornament to be proudly displayed at home.

INDIVIDUAL JOURNAL ASSIGNMENT:

Create memory hooks by using letters to make sentences or phrases to help you remember the concepts of ionic/covalent/metallic bonding.

HOMELINK:

Explain ionic/covalent/metallic bonding in terms of your family relationships.

STATE STANDARD # IV.B.3.c, IV.B.4.a, and I.D.3.

STUDENTS WILL BE ABLE TO:

- a) Classify compounds as being crystalline solids (ionic) or molecules (covalent) based on the transfer or sharing of outer electrons
- b) Relate the physical properties of compounds to their type of bonding
- c) Revise explanations or models after review

ESSENTIAL QUESTION: How does the discipline/sub-discipline of covalent bonding and compounds relate to mastery learning of chemical bonding?

15. LANGUAGE ARTS OR FOREIGN LANGUAGE OR COVALENT BONDING/COMPOUNDS

KNOWLEDGE:

Anticipatory Set: Demonstration of slime.

Students will: Make slime and identify the types of bonds holding it together.

COMPREHENSION:

After seeing a demonstration on perms from the cosmetology class, students will answer the following question: Could repeated chemical treatments used to either curl or straighten your hair alter the hair permanently?

APPLICATION:

Anticipatory Set: Molecular model kits in wood and plastic

Students will: Construct their own models of compounds using the molecular model kits.

Class/team product: Draw structural formulas for isomers of hydrocarbons.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Explain why ethnic groups' traditional uses of chemical treatments for the hair vary.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Compare the price of gasoline in the US to the price of gasoline in ten other countries.

SCHOOL-TO-CAREER/TECH PREP LINK:

Learn about the many ways in which supercomputers are used. Choose one and create a "How It Works" poster illustrating this technology.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Video clip from a computer-generated video (by Jan Hammer)

Students will: Use the ChemDraw CD ROM to build a model of their own choosing and be able to rotate the molecule to show a site for possible bonding.

Class/team/individual product: Build the model of the molecule that you designed with the ChemDraw CD ROM using materials of your choice.

INDIVIDUAL JOURNAL ASSIGNMENT:

Covalently bonded solids, such as silicon (element used in computer components) are harder than pure metals. Research theories that explain the hardness of covalently bonded solids and their usefulness in the computer industry.

HOMELINK:

Write a slogan for intramolecular and intermolecular bonding.

STATE STANDARD # IV. B.

STUDENTS WILL BE ABLE TO

- a) Identify single and double bonds and explain how this relates to the stability of a molecule
- b) Distinguish bond orbitals, bond angles, and molecular structures and shapes of various molecules

ESSENTIAL QUESTION: How does the discipline/sub-discipline of molecular structure relate to mastery learning of chemical bonding?

16. **ART/MUSIC OR FINE ARTS OR MOLECULAR STRUCTURE**

KNOWLEDGE:

Anticipatory Set: As students enter the room, the teacher will bounce the “happy ball.” Without being observed, the teacher will switch to the “sad ball” which looks the same, but does not bounce.

Students will: Describe what happened to the ball.

COMPREHENSION:

After viewing a photograph of C₆₀, buckminsterfullerene, students will be able to identify single and double bonds and explain how the type of bond relates to the chemical stability of this molecule.

APPLICATION:

Anticipatory Set: Clip from Willy Wonka’s Chocolate Factory.

Students will: Use gum drops and toothpicks to make models that represent the molecular shapes and bond angles that are found in the compounds formed from the elements of Groups 1, 2, and 13-18. The students will discuss with a partner as each model is made, the bonding orbitals, bond angles, and molecular shape of each model.

Class/team product: Gum drop and toothpick molecular models.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Write the directions for building gum drop and toothpick molecular models in Spanish/French/German or a language other than your native tongue.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Identify the geometric shapes of the molecular models.

SCHOOL-TO-CAREER/TECH PREP LINK:

What idea resulted in the creation of Velcro?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Explanation of how roach traps “work”

Students will: Design a network tree concept map that shows how hydrocarbons are classified as saturated and unsaturated. The student should map the type of bond (single, double, or triple) and the nomenclature (suffix) that is used with each type of bond. In addition, the student will indicate the approximate bond angle for each type of bond and draw a 3-7 carbon structure illustrating that type of bond.

Class/team/individual product: The network tree concept map.

INDIVIDUAL JOURNAL ASSIGNMENT:

List the types of orbital overlaps that can occur between half-filled orbitals in a sigma bond. Bring the list to class and ask the members of your group to add one type to a list constructed on the whiteboard. The list should include: two *s* orbitals, *s* and *p* orbitals, two *p* orbitals end-to-end, two hybrid orbitals, hybrid orbital and *s* orbital, and hybrid orbital and *p* orbital.

HOMELINK:

Initiate a family discussion about the dangers of oil spills.

STATE STANDARD # IV.B.1.a.

STUDENTS WILL BE ABLE TO:

Predict the charge a representative element will acquire based on its outer electron arrangement.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of molecular attraction relate to mastery learning of chemical bonding?

17. **PHYSICAL ED OR VOCATIONAL/TECHNICAL ARTS OR MOLECULAR ATTRACTION**

KNOWLEDGE:

Anticipatory Set: LCD panel with graphing calculator setup

Students will: Program their graphing calculator to determine the electro-negativity difference between bonded atoms for later use to classify bonding type.

COMPREHENSION:

The students will predict how the top of trees get water because pressure alone cannot force water to that height.

APPLICATION:

Anticipatory Set: Polar/Nonpolar Molecule Laboratory

Students will: Be able to make a general prediction based on the chemical formula of the solvent, a general rule for the solubility of polar and non-polar solvents and solutes.

Class/team product: Create a list of general rules for the solubility of polar and nonpolar solvents and solutes.

MULTICULTURAL and/or ESL and/or BILINGUAL LINK:

Compare the manufacturing process of gasoline in the US to the manufacturing process of gasoline in a third-world country.

MATHEMATICS/SCIENCE LINK and/or HUMANITIES LINK:

Write 2 riddles that illustrate the concept of bonding. For example: What's the name of 007's Eskimo cousin? Answer: Polar Bond

SCHOOL-TO-CAREER/TECH PREP LINK:

Shadow someone who works in a "dry cleaning" store. Find out why some cleaners prices are much lower than others.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

Anticipatory Set: Video clip of the television show, The Weakest Link

Students will: Work in teams and decide which type of bonding is the "Weakest Link" (e.g. ionic, covalent, van der Waals, hydrogen, London dispersion forces, and metallic). Each team will develop a list of questions about their type of bond and submit that list to the teacher.

Class/team/individual product: Playing of the game, "The Weakest Link". The teacher will act as the game show host, Ann Robinson, and call a member from each team to play the game in order to determine which member of the student team is the "Weakest Link," GOOD-BYE!

INDIVIDUAL JOURNAL ASSIGNMENT:

Write about the bond that was the "Weakest Link" in the game played in class and give 3-5 major reasons why this bond was the "Weakest Link."

HOMELINK:

If two children enter an ice cream shop and pool their money to buy an ice cream cone, draw a cartoon to illustrate the concept of covalent bonding with equal sharing. Draw a second cartoon to illustrate the concept of polar covalent bonding.

**MORAL/ETHICAL/SPIRITUAL
REASONING AND DILEMMAS**

- Producing, Exchanging, and Distributing** [Economics]
DILEMMA:
Suppose you were approached by one of the teams that have great potential to make the NBA play-offs and asked to create a product using flubber in athletic shoes for a huge sum of money. The only condition that is placed on your development is that the shoes cannot be sold to anyone else except this team until after the play-offs. What would you do?
- Transportation**
DILEMMA: Salting icy roads reduces driving hazards by increasing friction between the tire and road, as well as, causing the ice to melt. Damage to motor vehicles in the form of new pits in the body and rust spots from the chloride is being blamed on the use of salt on the roads in the winter. Assume that the practice of salting icy roads significantly decreases automobile accidents. Being involved in after school activities, having a part-time job, and having just bought your first car, how would you go about deciding whether the “trade-off” is worthwhile?
- Communications**
DILEMMA: How would you feel if your boyfriend/girlfriend just told you before class that, “We seem to be poles apart?”
- Protecting and Conserving**
DILEMMA: Fish are being killed in a nearby river of your community due to runoff from a manufacturing plant. Your father is an hourly worker along with 200 more community members at the plant. You work for the Department of Health and Environmental Control. It is your job to make the decision on whether the plant should remain open or shut down. This plant has been cited before for similar offenses. What decision will you make?
- Providing Education**
DILEMMA: Ritalin is commercially designed to act as a stimulant in people who are behaviorally “normal.” This drug has a calming effect on students who have attention disorders. Should Ritalin be prescribed to every student who has trouble sitting in his or her desk during a 90-minute block-scheduled class?
- Making and Using Tools and/or Technology**
DILEMMA: It is now technically possible to implant a chip in cell phones that will allow the cell phone user to be located at any time. The intent is for law enforcement officials to find you in emergency situations. The downside is that creditors can also locate you. What do you do?
- Providing Recreation**
DILEMMA: During a hike, your best friend experiences muscle spasms in her lower back. She knows that you have prescription pills for a muscle relaxer in your purse/wallet. She asks you for a pill to take. You know that you are not supposed to give others your medication, but since she is your best friend, you give her the pill to take. She has an allergic reaction to the medication and has to be evacuated by helicopter to the nearest hospital. What do you do?
- Organizing and Governing**
DILEMMA: The chemistry teacher has assigned everyone in your class a research paper on the proposal of a new scientific law based on data just released by the National Science Foundation. As the teacher hands back the graded papers, she/he announces that your friend is the state winner and will be going to Washington, D.C. to present his/her original scientific law at a national conference. If the paper is awarded the highest honor, the author receives a full scholarship to the college of their choice. As your teacher reads aloud your friend’s paper, you realize that this is “your” original paper that you gave your friend to turn in for you because you had a doctor’s appointment and would not be in class. Knowing that you are from a wealthy background and that your friend cannot attend college unless they receive a scholarship. What do you do?

9. **Moral, Ethical, and Spiritual Behavior**

DILEMMA: A woman has been diagnosed with breast cancer. After discussing her options with her family physician, she decides to seek alternative treatment. She has heard of a Native American healer who has had moderate success in treating breast cancer using herbs and dietary modifications. She visits the healer and decides to accept the alternative form of treatment. Her family does not want her to pursue alternative treatment: they prefer the traditional methods. You are their spiritual leader and the family comes to you for advice. What would you tell the family?

10. **Aesthetic Needs**

DILEMMA: A cosmetic company has its team of chemists working on an acne cream that will produce overnight results. There has been some short-term success during testing on human subjects. You are the head chemist and the President/CEO of the company is very pleased with your recent product development success and wants to pursue immediate FDA approval and put the product on the market. You want to continue the tests until you are absolutely sure that there are no health hazards that can be attributed from the use of this cream. You are told that if you delay FDA approval in marketing the product, you will be replaced and the product will be marketed anyway. What would you do?

**PRODUCTIVE THINKING SKILLS
DIVERGENT/CREATIVE THINKING**

1. **BRAINSTORM MODEL**

- A. BRAINSTORM ALL OF THE _____:
- AHA #1. substances that make your life easier
 - AHA #2. hazardous materials you can think of
 - AHA #3. shapes found in a bowling alley
 - AHA #4. items found in a landfill
 - AHA #5. objects in the environment affected by acid rain
 - AHA #6. tools and technology found in a chemistry lab
 - AHA #7. ways chemistry is found in athletics/athlete
- B. BRAINSTORM AS MANY _____ AS YOU CAN THINK OF.
- AHA #8. ways to arrange the elements
 - AHA #9. scientists who contributed to chemistry
 - AHA #10. products you use where a chemist was needed
 - AHA #11. compounds
 - AHA #12. polyatomic ions
 - AHA #13. combustion reactions
 - AHA #14. ionic compounds found in food
- C. HOW MANY WAYS CAN YOU COME UP WITH TO _____?
- AHA #15. combinations of elements to form covalent bonds
 - AHA #16. molecular shapes can form with oxygen bonding
 - AHA #17. justify the breaking of a chemical bond

2. **VIEWPOINT MODEL (Human or Animate) (Use Cultural Literacy Terms)**

- A. HOW WOULD _____ LOOK TO A(N) _____?
- | | |
|--------------------------------|---------------------------------|
| AHA #1. flubber | caveman |
| AHA #2. a flame | tank of gasoline |
| AHA #3. a blank sheet of paper | artist |
| AHA #4. recycling center | 1950's garbage collector |
| AHA #5. acid rain | hood of an expensive sports car |
| AHA #6. synthetic diamond | jewelry store |

- AHA #7. you could build a bridge from your home to anywhere place(s) would your bridge end?
 AHA #8. you are elected Student Body Pres. rules would you change?
 AHA #9. you find a mysterious canister at home would you do with it?

B. YOU CAN _____. WHAT _____?

- AHA #10. have all the technology in the world would you do to improve your classroom
 AHA #11. have anything made with metalloids how could you improve science
 AHA #12. change iron (II) to iron (III) procedure would you use
 AHA #13. reverse one thing that happened way will it make your life better
 AHA #14. create your own compound would it's formula look like
 AHA #15. create a model of a compound name would you give it
 AHA #16. make a gumdrop model of a shape bonding orbital and angles are there
 AHA #17. invent a watering system for trees supplies would you need

5. **FORCED ASSOCIATION MODEL (Use cultural literacy terms here)**

A. HOW IS _____ LIKE _____?

- AHA #1. flubber rubber
 AHA #2. time travel Gulliver's travels
 AHA #3. origami molecular models
 AHA #4. a landfill a taco
 AHA #5. purple rain the Statue of Liberty
 AHA #6. spot plate test tube
 AHA #7. dancing swimming

B. GET IDEAS FROM _____ TO IMPROVE _____.

- AHA #8. CNN your study habits
 AHA #9. the internet chemical warfare
 AHA #10. the school's cosmetology class your skin complexion
 AHA #11. food product nutrition information the taste of a food product
 AHA #12. the *Elements Handbook* metalloids
 AHA #13. tour teacher or other source Christmas or other decorations
 AHA #14. DHEC water quality

C. I ONLY KNOW ABOUT _____. EXPLAIN _____ TO ME.

- AHA #15. chemical bonding covalent bonds
 AHA #16. molecular structure single and double bonds
 AHA #17. electronegativity how it can help in determining bonding type

6. **REORGANIZATION MODEL**

A. WHAT WOULD HAPPEN IF _____ WERE TRUE?

- AHA #1. you could use flubber for fuel
 AHA #2. there were no compounds, only elements
 AHA #3. there were no rules for writing compound names
 AHA #4. all plastics were found to be toxic
 AHA #5. oil could not be transported from one country to another
 AHA #6. electricity had never been discovered
 AHA #7. men did not have a sense of smell

B. SUPPOSE _____ (HAPPENED)

WHAT WOULD BE THE CONSEQUENCES?

- AHA #8. anything with carbon in it was a liquid
 AHA #9. it was a crime to be an artist or a scientist
 AHA #10. dyes were not permitted in anything

- AHA #11. there were no rules for naming molecules
 AHA #12. you could make any atoms bond
 AHA #13. a chemical war broke out in the Middle East
 AHA #14. all ionic bonds were toxic

C. WHAT WOULD HAPPEN IF THERE WERE NO _____ ?

- AHA #15. computer chips
 AHA #16. man-made medicines
 AHA #17. hydrogen bonds

CULTURAL LITERACY/SPELLING LIST

Names

Jan Hammer
 Sherlock Holmes
 Lucretius
 James Clerk Maxwell
 Mendeleev
 Ivan Turgenev

coordinate covalent bond
 coordination number
 covalent bond
 crystalline structure
 decomposition reaction
 dipole interactions
 dispersion forces
 double covalent bond

noble gas structure
 nonpolar covalent bond
 octet rule
 oxidation number
 periodic table
 physical science
 pi bonds

Phrases

activity series of metals

double displacement reaction
 electrical charge
 electron configuration

polar covalent bond
 polar molecule
 representative elements
 Rohrschach inkblot

air pollution
 air quality index
 alkali metals
 alkaline earth metals
 antibonding orbital
 aromatic hydrocarbon
 atomic mass
 atomic number
 atomic orbital
 atomic particle
 atomic radii

electron dot formula
 energy levels
 freezing point
 germ warfare
 halide ion
 hybrid orbitals
 hydrogen bond
 ionic bond
 inner transition metals
 inorganic compounds
 ion exchange resin

Rosetta stone
 sigma bonds
 silicon chip
 Silicon Valley
 single displacement reaction
 skeleton equation
 tetrahedral angle
 tetrahedron
 transition metals
 triple covalent bond
 unpaired electrons

balanced equation
 bent angle
 boiling point
 bond dissociation energy
 bonding orbital
 carbon dioxide
 carbon monoxide
 chemical bond
 chemical compounds
 chemical element
 chemical symbol
 combination reaction
 combustion reaction

Law of Conservation of Mass
 Lewis dot structure
 logic matrix
 London forces
 mass number
 melting point
 metallic bonds
 molecular orbitals
 molecular solids
 net ionic equation
 network solids
 neutralization reaction
 noble gas

unshared pairs
 valence electrons
 van der Waals forces
 VSEPR theory

Dates

60 B.C.
 6th Century A.D.
 1861
 1873
 1975

Ideas

accelerators
 acid
 alkanes
 alkenes
 alkynes
 alien

alloy
 amok
 anion
 antisocial
 antithetical
 arena

arsenal
 assemblages
 atmosphere
 atom
 base
 binary

biochemistry	family	Origami
Bio-weapon	gasoline	orientation
bond	gladiator	oxides
calcite	gratuitous	paramagnetic
carbon	group	peroxides
catalyst	helix	polymers
cation	hybridization	prototype
chemistry	hydrocarbon	quantum
collage	ion	ramifications
column	isomers	resonance
compounds	lattice	seeding
conductivity	link	soliloquy
conductor	lobes	solute
cosmetology	martian	solvent
curator	mass	superconductor
diamagnetic	metal	superoxides
diffraction	metalloid	supersaturated
dipole	microprocessor	technology
drug	misgivings	ternary
electrolysis	neutron	transgenic
electron	nonmetal	velcro
electronegativity	nucleus	volatile
elements	octet	X-rays
equation	orbitals	
ethics	organic	

RESOURCES

I. Bibliography – Teacher/Professional Books and Resources

1. American Chemical Society (1994). Your Chemical World. Washington, DC.
2. Asimov, Isaac (1991). Atom. Truman Talley Books, Dutton, NY.
3. Atkins, P.W. The Periodic Kingdom: A Journey into the Land of the Chemical Elements.
4. Bolles, Edmund B. Galileo's Commandment. W.H. Freeman, NY.
5. Bilash II, Boris (1997). A Demo a Day. Flinn Scientific, Inc., Batavia, IL.
6. Crystal, David (1994). The Cambridge Factfinder. Cambridge University Press, NY.
7. Dickson, Paul (1996). What's in a Name? Merriam-Webster, Inc., Springfield, MS.
8. Feldman, David (1991). Do Penguins have Knees? Harper-Collins Publishers, NY.
9. Fruen, Lois (1994). The Real World of Chemistry. Kendall/Hunt Publishing Company, Dubuque, IA.
10. Galyean, Ronald (1993). Experience the Science of Food Laboratory Experiments in Food Science. Department of Food Science, Clemson University, Clemson, SC.
11. Glencoe Publishers (1995). Merrill Chemistry. Glencoe, NY.
12. Green, J. (1995). The Green Book of Songs by Subject. Professional Desk References, Inc., Nashville, TN.
13. Hellemans, A. and Bunch, B. (1991). The Timetables of Science: A Chronology of the Most Important People and Events in the History of Science. Simon and Schuster, NY.
14. Hirsch, E.D. Jr., Kett, J.F. and Trefil, J. (1988). Cultural Literacy: What Every American Needs to Know. Houghton Mifflin Company, Boston, MS.
15. Hirsch, E.D. Jr., Kett, J.F. and Trefil, J. (1988). The Dictionary of Cultural Literacy: What Every American Needs to Know. Houghton Mifflin Company, Boston, MS.
16. Holt, Rhinehart and Winston (1999). Modern Chemistry. NY, NY.
17. Jardine, Lisa (1999). Building the Scientific Revolution. Doubleday, NY.
18. Kendall/Hunt Publishing Company (1996). Chemistry in the Community. Dubuque, IA.
19. Kipfer, Barbara (1997). The Order of Things. Random House Publishers, NY.
20. Lange, Norbert. Lange's Handbook of Chemistry. McGraw-Hill, NY.
21. Limericks. Chem 13 News, May 1988.

22. Levi, Primo (1975). "Carbon", The Periodic Table.
23. Lucretius (ca. B.C.). "The Persistence of Atoms", On the Nature of Things.
24. Maxwell, James Clerk (1873). "Molecules", Nature.
25. McMillin, David (2001). Chemistry Math Concepts. Flinn Scientific, Inc., Batavia, IL.
26. "Protochemistry", Journal of Chemical Education (Volume 66). American Chemical Society, Washington, DC.
27. Ridgeway, James (Dec. 14, 1999). "Mondo Washington", The Village Voice. NY.
28. Schwartz, A.T. et al. Chemistry in Context. McGraw-Hill, NY.
29. Shakashiri, Bassam. Chemical Demonstrations: A Handbook for Teachers of Chemistry. University of Wisconsin Press, Madison, WI.
30. Stone, Judith (1991). Light Elements. Ballentine Books, NY.
31. Summerlin, Lee and Ealy, James. Chemical Demonstrations: A Sourcebook for Teachers. American Chemical Society, Washington, DC.
32. Trefil, J. and Hazen, R. (1998). The Sciences an Integrated Approach. John Wiley and Sons, Inc., NY.
33. Waddell, Thomas and Rybolt, Thomas (1999). "The Chemical Adventures of Sherlock Holmes", Journal of Chemical Education (Volume 166). American Chemical Society, Washington, DC.
34. Williamson, Kenneth L. (1989). Macroscale and Microscale Organic Experiments. D.C. Heath.
35. Woodrow Wilson National Fellowship Foundation (Summer 1995). "Teachers Outreach (TORCH) Program for Teachers in Science, Mathematics and History".

II. Bibliography – Student Books on loan from Media Center for classroom use.

Books:

1. Auel, Jean. Clan of the Cave Bear.
2. Carson, Ben. Gifted Hands.
3. Carroll, Lewis G. Alice in Wonderland.
4. Homer. The Iliad.
5. Homer. The Odyssey.
6. Larson, Gary. A Farside Collection. Andrews and McMeel, Kansas City
7. McCall, Nathan. Makes me Wanna Holler.
8. Silverstein, Shel. Falling Up. Harper-Collins Publishers
9. Swift, Jonathan. Gullivers Travels.
10. Turgenev, Ivan (1861). Fathers and Sons.
11. Wells, H.G. The War of the Worlds.

Magazines/Periodicals:

12. Chem 13 News
13. ChemMatters
14. Journal of Chemical Education
15. National Geographic
16. NEA Today
17. Reader's Digest
18. Time
19. US News

Reference:

20. Addison-Wesley Chemistry Textbook
21. Addison-Wesley Laboratory Manual
22. Addison-Wesley Small-Scale Laboratory Manual
23. Brown-LeMay Chemistry Textbook
24. Chemistry in the Community Textbook

III. Educational Films/Videos

1. *Chemical Bonding and Atomic Structure* (Coronet/NTI Film and Videos, Deerfield, IL)
2. CHEM Study Films and Videos (Ward's Natural Science Establishment, Inc. Rochester, NY)

- a. *Chemical Bonding*
- b. *Crystals and their Structures*
- c. *Electric Interactions in Chemistry*
- d. *Shapes and Polarities of Molecules*
3. Laboratory Safety, Flinn Scientific, Inc., Batavia, IL
4. Solo-Learn: (Auto-tutorial programs from Ward's Natural Science Establishment, Inc., Rochester, NY).
 - a. *Introduction to Chemical Bonding*
 - b. *Polar Covalence*
 - c. *Bond Types and Properties of Matter*
5. The World of Chemistry: Program 7 The Periodic Table (RNHS ITC)

IV. Commercial Films/Videos

- | | |
|--|---|
| 1. 101 Dalmatians | 32. La Jetee |
| 2. Alien | 33. Madame Curie |
| 3. Apollo 13 | 34. Magic School Bus videos and computer software |
| 4. Arsenic and Old Lace | 35. Mimic |
| 5. Awakenings | 36. Mission to Mars |
| 6. Back to the Future | 37. Mystery Men |
| 7. Batman and Robin | 38. Predator |
| 8. City of Angels | 39. RoboCop |
| 9. Clan of the Cave Bear | 40. Quest for Fire |
| 10. Clash of the Titans | 41. Star Trek (all of the Motion Pictures) |
| 11. Close Encounters of the Third Kind | 42. The Blob |
| 12. Contact | 43. The Bone Collector |
| 13. DOA | 44. The China Syndrome |
| 14. Doctor Dolittle | 45. The Dark Wind |
| 15. Einstein | 46. The Iron Giant |
| 16. Erin Brockovich | 47. The Last Starfighter |
| 17. ET | 48. The Matrix |
| 18. Fallen | 49. The Mummy |
| 19. Fat Man Little Boy | 50. The Race for the Double Helix |
| 20. Field of Dreams | 51. The Star Wars Trilogy |
| 21. Flubber | 52. The Terminator |
| 22. Frankenstein | 53. The Time Machine |
| 23. Ghostbusters | 54. The War of the Worlds |
| 24. Goldfinger | 55. Tomorrow Never Dies |
| 25. Gladiator | 56. Tron |
| 26. Harriet the Spy | 57. "What Smells", NOVA 1992 |
| 27. Honey, I Shrunk the Kids | 58. What Women Want |
| 28. Independence Day | 59. Willy Wonka's Chocolate Factory |
| 29. Indiana Jones and the Temple of Doom | 60. X-Men |
| 30. Inspector Gadget | |
| 31. Jurassic Park | |

V. Literature/Language Arts (on reserve in Media Center)

Fiction

1. Cook, Robin. Acceptable Risk.
2. Cook, Robin. Contagion.
3. Crichton, Michael. Jurassic Park.
4. Crichton, Michael. Timeline.
5. Deaver, Jeffrey. The Bone Collector.
6. Dixon, Franklin. Bad Chemistry (Hardy Boys Case Files, Number 110).
7. Doyle, Sir Arthur Conan. Sherlock Holmes Mysteries.

8. Grubb, Lydia. Doing Chemistry: A Story for Women.
9. Kelly, Nora. Bad Chemistry (Missing Mystery 21).
10. Krist, Gary. Bad Chemistry.
11. Soderquist, Larry D. The Labcoat.
12. Taylor, Joseph. Murder by Chemistry.

Non-Fiction

1. Barr, George. Science Research for Young People.
2. Heiserman, David L. Exploring Chemical Elements and their Compounds.
3. Hyerle, David. Thinking Maps: Tools for Learning.
4. Landwehr, James and Watkins, Ann. Exploring Data.
5. Leicester, Henry. The Historical Background of Chemistry.
6. Levine, Joseph and David Suzuki. The Secret of Life.
7. Mensa. The Covert Challenge.
8. Mensa. Lateral Thinking and Logical Deduction.
9. Morgan, Larry. Explorations.
10. Pert, Candace. Molecules of Emotion.
11. Pickering, David. Dictionary of Superstitions.
12. Schmallerger, Frank. Trial of the Century.
13. Sertima, Ivan. Blacks in Science Ancient and Modern.
14. Smith, Kurt. Math Logic Puzzles.
15. Smith, Michael B. and March, Jerry. March's Advanced Organic Chemistry.
16. Solomons, T.W. Graham, etal. Organic Chemistry.
17. Vis-Ed. General Chemistry I.
18. Vis-Ed. Inorganic Chemistry Nomenclature.
19. Vis-Ed. Inorganic Chemistry Reactions.
20. Wuts, Peter and Greene, Theodora. Protective Groups in Organic Synthesis.
21. Weissermel, Klaus. Industrial Organic Chemistry.

Poetry

1. "Invictus" W.E. Henley
2. Limericks Chem 13 News January 1972
3. Limericks Chem 13 News April 1975
4. Limericks Chem 13 News May 1981
5. Limericks Chem 13 News September 1981
6. Limericks Chem 13 News May 1988
7. "ChemSpeak" Henry R. Martin
8. "At Sea" John Idhe
9. "I Get a Charge Out of You" John Idhe
10. "Multiple Attractions" John Idhe
11. "No Give Just Take" John Idhe
12. "Not So Noble Gases?" John Idhe
13. "Twinkle, Twinkle, Little Star Nursery Rhyme

Drama (Stage Productions)

1. A Streetcar Named Desire
2. Bring on da Noise Bring in da Funk
3. Cats
4. Dream Girls
5. Raisin in the Sun
6. Rent
7. Steel Magnolias
8. The Effect of Gamma Rays on Man-in-the-Moon Marigolds
9. The Glass Menagerie

Art Works

1. Fichner-Rathus (1986). Understanding Art. Prentice-Hall
2. Franc, Helen (1995). An Invitation to See 150 Wroks from the Musuem of Modern Art.
3. Howard, Kathleen, editor. The Metropolitan Guide, 1994.
4. Janson, H.W. (1995). History of Art. Harry N. Abrams, Inc.
5. Philadelphia Museum of Art: Handbook of the Collections, 1999.

Music

- | | | |
|-----|-------------------------------------|-----------------------|
| 1. | Distorted Cirque Du Soliel, | “La Nouba” |
| 2. | “Eternal Flame” | Bangles |
| 3. | “Gettin’ Jiggy wit it” | Will Smith |
| 4. | “Lucy in the Sky with Diamonds” | Beetles |
| 5. | “Kryponite” | 3 Doors Down |
| 6. | “Let’s Get Physical” | Olivia Newton-John |
| 7. | “Makes me Wanna Holler” | Marvin Gaye |
| 8. | “Open Arms” | Journey |
| 9. | “Purple Rain” | Prince |
| 10. | “Step by Step” | New Kids on the Block |
| 11. | Theme from “The Weakest Link” | NBC/Napster |
| 12. | “Who Can it be Now?” | Men at Work |
| 13. | “Who Let the Dogs Out?” | The Baja Boys |
| 14. | “You Don’t Have to Call me Darlin’” | David Alan Coe |

VI. Resource People/Mentors

1. Chemical Warfare Speaker from Fort Jackson
2. Lyn King, Media Specialist, RNHS
3. Elaine Sudduth
4. Tie-Dye Guy

VII. Field Trips

1. Capsugels Plant
2. Fuji
3. Honeywell
4. Michelin
5. Pirelli
6. Water Soluble Textiles Plant

VIII. Other Material (CD-ROM, Laser Disc, Internet sites, etc.)

Cartoons:

1. All Star Exterminators
2. Batman Beyond
3. X-Men

Television Shows:

- | | | | |
|-----|------------------------------|-----|--------------------|
| 1. | 48 Hours | 12. | La Femme Nikita |
| 2. | Babylon 5 | 13. | Law and Order |
| 3. | Baywatch | 14. | Medical Detectives |
| 4. | Biography | 15. | Nero Wolfe |
| 5. | CNN | 16. | New Detectives |
| 6. | CSI | 17. | NYPD Blue |
| 7. | Dateline NBC | 18. | Perry Mason |
| 8. | Homicide: Life on the Street | 19. | Profiler |
| 9. | JAG | 20. | Sliders |
| 10. | Justice Files | 21. | Star Trek |
| 11. | Killer App | 22. | The FBI Files |

- 23. The Secrets of Forensic Science
- 24. The X-Files

- 25. Weakest Link
- 26. Wild Wild West

Internet References:

- 1. <http://www.aaas.org> (American Association for the Advancement of Science)
- 2. <http://www.astr.va.edu/4000WS> (Women in Science)
- 3. <http://www.branson.k12.mo.us/langarts/cmflower/rorschach.html>
- 4. <http://www.cbiac.apgea.army.mil>
(The Chemical and Biological Defense Information Analysis Center)
- 5. <http://www.ChemKids.com/> (Chem-4-Kids)
- 6. <http://nysaes.cornell.edu/flavornet>
- 7. http://www.dir.yahoo.com/news_and_media/Television Shows
- 8. <http://www.dowclean.com>.
- 9. <http://www.foresight.com>
- 10. <http://www.imbd.com> (Internet Movie Database)
- 11. <http://www.nature.com> (Nature Magazine)
- 12. <http://www.netsrq.com/ndbois/> (Distinguished Women of Past and Present)
- 13. <http://www.nobelchannel.com>
- 14. <http://www.nsf.gov> (National Science Foundation)
- 15. <http://www.nytimes.com>
- 16. <http://www.okstate.edu> (Chemical Bonding Concept/Skills Development)
- 17. <http://www.osha-slc.gov/SLTC/solvents/> (Occupational Safety and Health Administration)
- 18. <http://www.pbs.org>
- 19. <http://www.pubs.acs.org/hotartcl/chemtech>
- 20. <http://www.physics.ucla.edu/nwcp> (Contributions of 20th Century Women to Physics)
- 21. <http://www.schoolsdiscovery.com>
- 22. <http://www.tamucc.edu>
- 23. <http://www.thechalkboard.com>
- 24. <http://www.theperiodic-table.com>
- 25. <http://www.webelements.com>