WE'VE GOT CHEMISTRY!

Grade Level or Special Area: 4th Grade
Written by: Adina Felten, Crown Pointe Academy, Westminster, CO
Length of Unit: Five lessons (approximately three weeks (14 days); one day=45 minutes)

I. ABSTRACT

Our lives have been greatly influenced by chemistry from the rubber soles on the shoes we wear to x-ray machines doctors use daily to detect abnormalities in time to save a person's life. Because of its wide reaching effects on our everyday lives, it is crucial for students to learn the essentials of chemistry. This unit contains a multitude of experiments and activities centered around atoms and molecules, states and properties of matter, elements and compounds, mixtures and solutions. As a culmination to this study, students will visit stations where they truly get elbow deep in ooey, gooey, slimy solutions.

II. OVERVIEW

A. Concept Objectives
   1. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)
   2. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)
   3. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
   4. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)

B. Content from the *Core Knowledge Sequence* p.104-105
   1. Science: Chemistry: Basic Terms and Concepts
      a. Atoms
         i. All matter is made up of particles too small for the eye to see, called atoms.
         ii. Scientists have developed models of atoms; while these models have changed over time as scientists make new discoveries, the models help us imagine what we cannot see.
         iii. Atoms are made up of even tinier particles: protons, neutrons, electrons.
         iv. The concept of electrical charge:
            a) Positive charge (+): proton
            b) Negative charge (-): electron
            c) Neutral (neither positive nor negative): neutron
            d) "Unlike charges attract, like charges repel" (relate to magnetic attraction and repulsion)
      b. Properties of Matter
         i. Mass: the amount of matter in an object, similar to weight
         ii. Volume: the amount of space a thing fills
         iii. Density: how much matter is packed into the space an object fills
         iv. Vacuum: the absence of matter

c. Elements
    i. Elements are the basic kinds of matter, of which there are a little more than one hundred. There are many different kinds of atoms, but an element has only one kind of atom. Familiar elements, such as gold, copper, aluminum, oxygen, iron. Most things are made up of a combination of elements.

d. Solutions
    i. A solution is formed when a substance (the solute) is dissolved in another substance (the solvent), such as when sugar or salt is dissolved in water; the dissolved substance is present in the solution even though you cannot see it.
    ii. Concentration and saturation (as demonstrated through simple experiments with crystallization)

C. Skill Objectives
1. Students will recognize what atoms are, particles they are made up of, and that these particles (protons, neutrons, and electrons) each hold an electrical charge.
2. Students will illustrate and label the parts of Bohr's atomic model, realizing that this model has evolved greatly over time with technological advancements.
3. Students will identify the three states of matter as solid, liquid, and gas.
4. Students will understand that all substances have identifying characteristics or properties and will become familiar with matter's properties such as mass, volume, and density (and that a vacuum is the absence of matter).
5. Students will familiarize themselves with several elements of the periodic table including gold, copper, aluminum, oxygen, and iron.
6. Students will apply their cognition of the periodic table in creating their own atomic model of an assigned element in which they will include the element name, symbol, atomic number and weight, and the correct number of protons, neutrons, and electrons.
7. Students will experiment with different concentrations of sugar and salt to make a crystallized substance, which will represent how different crystals form in nature.
8. Students will differentiate between the solvent and solute upon creating a variety of solutions.
9. Students will determine causes for variations in dissolving time including heat and particle size.

III. BACKGROUND KNOWLEDGE

A. For Teachers
1. Georges, Jason and Tracy Irons-Georges. *Rourke's World of Science Encyclopedia: Chemistry*
2. Kerrod, Robin and Dr. Sharon Ann Holgate. *The Way Science Works*
3. Lafferty, Peter. *Macmillan Encyclopedia of Science: Matter and Energy*

B. For Students
1. Grade 1: Matter, Properties of Matter
2. Grade 2: Law of Magnetic Attraction
3. Grade 4: Electricity

IV. RESOURCES

A. *What Your Fourth Grader Needs to Know* pp. 375-376, by E.D Hirsch Jr. (Lesson One)
B. *Macmillan Encyclopedia of Science: Matter and Energy* pp. 18-20, by Peter Lafferty (Lesson One)

C. *Changing from Solids to Liquids to Gases*, by Brian Knapp (Lesson Two (optional))
D. *Rourke's World of Science Encyclopedia: Chemistry* pp. 27-32, by Jason Georges and Tracy Irons-Georges (Lesson Two)
E. *The Way Science Works* p. 47, by Robin Kerrod and Dr. Sharon Ann Holgate (Lesson Three)
F. *Investigations in Science: Chemistry* p. 18, by Phil Parratore (Lesson Three)
G. *Icky Sticky Foamy Slimy Ooey Gooey Chemistry*, by Kristine Petterson (Culminating Activity)
H. *Chemistry For Every Kid*, by Janice VanCleave (Culminating Activity (optional))

V. LESSONS

Lesson One: Atoms and Molecules (two days)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)
      b. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
      c. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)
   2. Lesson Content
      a. All matter is made up of particles too small for the eye to see, called atoms.
      b. Scientists have developed models of atoms; while these models have changed over time as scientists make new discoveries, the models help us imagine what we cannot see.
      c. Atoms are made up of even tinier particles: protons, neutrons, electrons.
      d. The concept of electrical charge: positive charge (+): proton, negative charge (-): electron, neutral (neither positive nor negative): neutron; "unlike charges attract, like charges repel"
   3. Skill Objective(s)
      a. Students will recognize what atoms are, particles they are made up of, and that these particles (protons, neutrons, and electrons) each hold an electrical charge.
      b. Students will illustrate and label the parts of Bohr's atomic model, realizing that this model has evolved greatly over time with technological advancements.

B. *Materials*
   1. Appendix A: Introducing Chemistry (one copy per student)
   2. Appendix B: Reviewing Atoms and Molecules (one copy per student)
   3. *What Your Fourth Grader Needs to Know* pp. 375-376, by E.D Hirsch Jr.
   4. *Macmillan Encyclopedia of Science: Matter and Energy* pp. 18-20, by Peter Lafferty

C. *Key Vocabulary*
   1. Chemistry – study of the properties and makeup of substances and the changes they undergo
   2. Atom – smallest particle of an element which can exist and still retain the properties of that element

3. Molecule – smallest particle of a compound which can normally exist by itself and still have the properties of that substance
4. Nucleus – central portion of an atom, where the protons and neutrons are located
5. Proton – positively charged particle in the nucleus of an atom
6. Neutron – neutral, uncharged particle in the nucleus of an atom
7. Electron – negatively charged particle in an atom
8. Electron shell – electrons of an atom revolve in shells about the nucleus; force of electrons' orbits prevents them from being drawn into the nucleus

D. *Procedures/Activities*

1. Ask students what comes to mind when they hear the word "Chemistry." Make a web on the board, branching all their brainstormed ideas around the word "chemistry."
2. Read Appendix A: Introducing Chemistry. Refer back to the brainstorm web on the board. Put stars by all the concepts that were correct, erase incorrect notions, and add other facts learned after reading the information.
3. Hand out Appendix B: Reviewing Atoms and Molecules. Have students work in pairs to answer the questions. They may refer back to Appendix A if necessary.
4. Review answers as a whole class: 1. An atom is the smallest unit of a chemical element, which makes up all matter in the universe. 2. Atoms are too small to be seen with the naked eye. Even the tiniest speck of dust contains millions of atoms. 3. The parts of the atoms are the proton, neutron, and electron. At the atom's center is a core or cluster called a nucleus made up of the protons and neutrons. The electrons orbit around the nucleus. 4. The proton has a positive charge, the neutron has no charge, and the electron has a negative electrical charge. Particles with similar charges repel and particles with opposite charges attract (opposites attract).
5. Have students add a few additional notes about the concept of electrical charge on the back of their sheets. Also remind them about studying electrical charge during their previous Electricity Unit:
   a. materials that pick up extra electrons are *negatively charged*
   b. materials that lose electrons become positively charged
   c. materials with the same charge repel (move away) from each other
   d. materials with different charges attract (move closer) to each other
   e. materials with neutral charges are attracted to both objects with positive or negative charges
   f. Ex:

-	+	attract
+	+	repel
-	-	repel
+	0	attract
-	0	attract

   g. most atoms have the same number of protons and neutrons in the nucleus; the same number of electrons will be orbiting
   h. sometimes nucleus of atom can have extra neutrons causing it to be unstable or *radioactive* (when neutrons in nucleus breaks down into electrons and protons, releasing radiation in the process)
6. Read information about Marie Curie from *What Your Fourth Grader Needs to Know* pp. 375-376. Discuss how many early scientists risked their lives to contribute knowledge to their fields that we use today. Explain that while working with radioactive particles was damaging to both her and her husband,

this discovery led to radiation being used to treat cancer, which in turn has drastically affected millions of cancer patients over the years. Tie in the fact that many inventions have this "double-edged" sword effect; that technological advancements have brought us so much further, but have consequences in return (Ex: cars-pollution, nuclear power plants-radiation poisoning, etc.) This is a good time to tie in how further research of atomic parts led to the discovery of the atomic bomb (by splitting apart atoms). Again discuss consequences of such discoveries.

7. Have students turn their papers back over, so that they are again working on Appendix B. Read pages 19-20 from *Macmillan Encyclopedia of Science: Matter and Energy*. Point out the different atomic models that were developed over the years from 1802-1913. Mention that the models became more accurate as more and more information was discovered about the atom. Draw pictures of these models, such as the one from p.19, on the board. Have students copy these pictures down on their sheets under the heading "Models of Atoms." Underneath each they need to write the name of the model along with the year it was made. (Dalton's "billiard ball" 1802, Thomson's "plum pudding" 1897, Rutherford's "electron cloud" 1911, and Bohr's "electron shell 1913.) Be sure to explain that the electron shell is the model scientists use today. Although many books will show only the electron cloud model, this is not truly accurate since it has since been outdated and replaced by a new model.
8. Read p. 18 from *Macmillan Encyclopedia of Science: Matter and Energy*, which lists a variety of interesting facts about atoms and molecules.
9. Have students list at least three of these facts that they find interesting onto their sheets (still Appendix B) under the heading "Interesting Atomic Facts."
10. Give the assessment at the beginning of the next lesson.

E. *Assessment/Evaluation*
   1. Students will illustrate and label the parts of Bohr's atomic model, identifying the electrical charge of each part. Under the diagram students will write one-two sentences about what atoms are and why models are helpful in our understanding of the atom.

Lesson Two: States and Properties of Matter (five days)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)
      b. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)
   2. Lesson Content
      a. Mass: the amount of matter in an object, similar to weight
      b. Volume: the amount of space a thing fills
      c. Density: how much matter is packed into the space an object fills
      d. Vacuum: the absence of matter
   3. Skill Objective(s)
      a. Students will identify the three states of matter as solid, liquid, and gas.
      b. Students will understand that all substances have identifying characteristics or properties and will become familiar with matter's properties such as mass, volume, and density (and that a vacuum is the absence of matter).

B. *Materials*

1. *Changing from Solids to Liquids to Gases*, by Brian Knapp (optional)
2. One roll of masking tape
3. Underwater Volcano Demonstration Materials:
   a. a large jar
   b. a small bottle that will fit inside the jar
   c. a long piece of string
   d. cold tap water
   e. hot tap water
   f. red food coloring
4. Appendix C: Scientific Process Experiment Form (transparency and one copy per student)
5. Balloon on the Bottle Demonstration Materials:
   a. one narrow-necked bottle
   b. funnel
   c. small uninflated balloon
   d. vinegar
   e. one teaspoon baking soda
6. *Rourke's World of Science Encyclopedia: Chemistry* pp.27-32, by Jason Georges and Tracy Irons-Georges
7. Identifying Matter Activity:
   a. shoebox
   b. a towel
8. Appendix D: Volume of Juice Experiment (one copy per student)
9. Volume of Juice Experiment Materials:
   a. one short, fat drinking glass
   b. one tall, narrow drinking glass
   c. one carton of orange juice
   d. liquid measuring bowl
10. Floating Boat Demonstration Materials:
    a. glass tumbler
    b. ball of modeling clay with 2" diameter
    c. two-three marbles
11. Appendix E: Which Will Drop First? (one copy per student)
12. Mass Experiment Materials per groups of four-five students:
    a. one ping-pong ball
    b. one golf ball
13. Liquid Layers Demonstration Materials:
    a. one clear drinking glass
    b. one cup corn syrup
    c. one cup water
    d. one cup cooking oil
14. Appendix F: Floating Eggs-periment (one copy per student)
15. Floating Eggs-periment Materials per group of two students:
    a. one clear plastic drinking glass
    b. one fresh egg
    c. one plastic spoon
    d. one-half cup of salt

C. *Key Vocabulary*

1. Solid – one of the three main states of matter where the particles are bonded rigidly together

2. Liquid – one of the three main states of matter where particles can move, but not independently
3. Gas – one of the three main states of matter where particles travel freely at very high speed
4. Mass – measure of the amount of matter in an object
5. Volume – amount of space taken up by matter
6. Density – amount of mass for a certain volume; how much matter packed into the space an object fills
7. Vacuum – the absence of matter

D. *Procedures/Activities*

1. **States of Matter**: Without yet giving the definition of matter, tell students that at the word "Go" they will have 30 seconds to find a piece of matter and return to their seats. Have students race, and have several students share their objects and why they think it is an example of matter.
2. Tell students they were all successful because matter is anything that has mass (for now say "weight" until mass is further defined) and takes up space. Explain that all matter can be found in one of three forms: solid, liquid, and gas. Brainstorm different examples of each and list these on the board in three separate columns. Discuss the uniqueness of water and how it can be shown in its three states. Explain how temperature will affect a substance and change its material state. Refer back to the water cycle studied earlier in the year and how this shows the three states of matter through evaporation, condensation, and precipitation. If more background information is needed for states of matter, *Changing from Solids to Liquids to Gases* is a good resource.
3. Mark off a large square on the classroom floor with masking tape, leaving one side open. Tell students that the square represents a jar. Have all students stand within the square and tell them that they are water in the jar. Each person is an atom and should be standing shoulder to shoulder with another person, packed together tightly in the square. (Mention that water is really a group of two different kinds of atoms, but for now, we are keeping it simple.) Tell students that when water is frozen in solid form, the molecules are packed closely together just like they are. This is the case in all solids, the atoms are locked together and cannot change shape without being pushed or pulled. Tell students that the sun is coming out and they are beginning to warm up. Ask them what they think might happen to them. Have students start moving a bit back and forth. Soon they can slowly start to move around. Tell them that they are now water in the jar. Just as they did, when a solid changes to a liquid state, the particles can slide past one another and have no fixed shape. They still take up about the same amount of space as the solid. When several students get near the mouth of the jar, allow a few to get out and walk around the room. Tell students that the jar is boiling and the atoms are rising up and out. Let students leave the jar until everyone is wandering around the room. Tell students that when liquid heats up to its melting point, the particles are no longer attached to one another and fly around. They bounce into one another, pushing each other apart until they are evenly spaced. The more room there is for them to fill, the further apart the particles will be. A gas has no fixed size or shape, and it always takes up more space than a solid or a liquid. Allow students to bounce around the classroom. They are to walk in a straight line until they hit something. Then they need to bounce off and move in a straight line in a new direction. Continue for a few minutes and then return back to regular seats. (An option is to repeat the process beginning as a gas, turning to a liquid, and ending as a solid.)

4. **Underwater Volcano Demonstration.** Tell students that they will have a chance to see all three states of matter in a demonstration where we create an underwater volcano. Hand out Appendix C: Scientific Process Experiment Form. (Note: If students are not familiar with the scientific process, you may need to spend some extra time explaining these steps before performing the demonstration.) Have students fill out the question, "How can an underwater volcano show the three states of matter?" Give students a minute to record their hypotheses. Next have students copy the following materials onto their sheets: a large jar, small bottle that will fit inside the jar, a long piece of string, cold tap water, hot tap water, red food coloring. Students will need to now write down the following steps under their "Procedures" section:
   a. Mix red food coloring with cold tap water in the small bottle and freeze solidly.
   b. Tie the string around the bottle's neck and tie the ends together so that the string acts as a long handle for the bottle.
   c. Fill the large jar three fourths full with hot water and lower the smaller bottle into it using the string handle.
   d. Once the small bottle of frozen red water thaws and becomes liquid, take it out of the large jar.
   e. Replace the hot water in the large jar with boiling water.
   f. Lower the bottle of red liquid into the large jar again until the red liquid is very hot.
   g. Now replace the water in the large jar once more, but this time with cold water.
   h. Lower the small bottle in the large jar one more time and watch the results.
5. Perform the demonstration for students following the procedure. Allow students time to record their results. Discuss how the liquid rose up out of the bottle like lava from an erupting volcano. Have students think about why this happened, formulate conclusions, and record them on their experiment forms. Discuss how the heat gave the water molecules energy, causing them to move apart from the solid shape until it became a liquid. As it was heated more and more, the molecules were bouncing around off each other and wanted to escape the bottle. The more heat that was added, the more energy the molecules got, causing them to move farther apart and take up more space. When the cold water was added in the large jar, the hot water was less dense than the cold water, so it rose to the top of the jar. (Tell students that they will soon learn more about density and how this works.)
6. **Balloon on the Bottle Demonstration**. Tell students that not all gases are formed from heating liquids. Sometimes gases can form as a result of a chemical reaction. Use the example of breathing out carbon dioxide. This carbon dioxide inside our body is formed by a chemical reaction that takes place inside the bloodstream. Explain that we will show carbon dioxide being formed inside a bottle. Mention that when a pop can is opened, the gas bubbles rush up to the top to leave the liquid through the air. The gas inside the pop is actually carbon dioxide that was pumped into the soda before it was sealed. For this activity use the transparency of Appendix C and write down the question, "How can we cause a balloon placed on a jar's mouth to fill up with carbon dioxide?" Take a few students' suggested answers and record a hypothesis. For materials record: narrow-necked bottle, funnel, small uninflated balloon, vinegar, one-teaspoon baking soda. Write down and then demonstrate the following steps:

a. Pour the vinegar into the bottle, filling it one fourth of the way.
b. Use the funnel to fill the balloon with baking soda and stretch it over the bottle's neck, so that the baking soda inside the balloon hangs down over the side without spilling into the bottle.
c. Quickly upend the balloon so that the baking soda spills into the vinegar.
d. Watch and record results.

7. Discuss results with students. What should happen is that the balloon will soon inflate. Ask students why they think this happened. As a conclusion, record that the baking soda mixing with the vinegar caused a chemical reaction releasing carbon dioxide gas. The mixture began to fizz as the molecules were bouncing around rapidly, trying to escape. The molecules soon found more room by rising up into the balloon, causing it to inflate.
8. **Properties of Matter**: Again give students 30 seconds to race around the room to gather a piece of matter. Once students have their items, have a few students share them and state whether it is solid, liquid, or gas.
9. **Identifying Matter Activity:** Tell students to close their eyes. Gather together five or six students' pieces of matter that are small enough to fit into a shoebox and cover the shoebox with a towel. Call forward a volunteer to reach under the towel and feel one of the items. Have them tell the class if it is a solid, liquid, or gas according to what they felt. Ask the class if this is enough information to guess what the item is. Take a few guesses. Most likely they will need more information. Tell students that to identify substances, they need some identifying characteristics or details. Have the volunteer tell the class some clues using his sense of touch again, such as if the item is big or small, smooth or rough, etc. See if after giving these details to the class they can guess it yet. If not, have the volunteer peek at the item without showing the rest of the class and describe it in more detail including color, shape, etc. Continue to add clues until the class can guess the item. Repeat this activity several times with other items from the box and other volunteers.
10. Tell students that for scientists to be able to describe different types of matter, including various similar metals or gases, they also need identifying characteristics or properties that distinguish them. Explain that some examples of these include the mass, volume, and density of an object.
11. Read pp.27-32 from *Rourke's World of Science Encyclopedia: Chemistry*. Have students record definitions of mass, volume, and density onto notepaper. Explain that a vacuum is the absence of matter. Ask students where they might find an example or demonstration of a vacuum. After a few responses mention that since the only place a vacuum can be found is in a black hole in outer space, we will not be able to perform an experiment showing this property of matter. However, we will be able to perform experiments for the properties of matter including mass, volume, and density.
12. **Volume of Juice Experiment**: Hand out Appendix D: Volume of Juice Experiment. Read together the question and have students record their hypotheses onto their sheets. Looking at two juice glasses, one long and narrow, the other short and fat, students are to guess which one has the most volume. Write the definition for volume up on the board for those students who need the reminder. Read together the materials and procedure. Demonstrate the procedure for students and have them record results and conclusions. Discuss together how the two glasses can have the same amount of liquid even though the liquid went up to a much higher level on the narrow glass. Explain that liquid will take on whatever shape the container is, making it difficult to tell the exact

amount without measuring. Mention that it is important to take this into consideration when buying grocery products. They need to look at the label to see what the liquid volume of an item is rather than looking at the size of the bottle when making a price comparison.

13. **Floating Boat Demonstration**: Drop a ball of modeling clay into a glass of water. Show students that it sinks. Drop a few marbles down into the water showing them sink as well. Now mold the clay into a small bowl. Place it on the water showing that it floats. It should be able to support one or two marbles on it as well. Explain to students that here, the volume of an object was changed without adding to or taking away any materials; the same amount of clay was used for both the ball and boat. However, changing its shape changed the way it supported itself in the water. Point out that as a boat it had a larger volume; it took up more space in the water, but could distribute its weight more evenly and over a larger area.

14. **Mass Experiment**: Hand out Appendix E: Which Will Drop First? Divide class into groups of four (or five). Since experiment procedures have been teacher led and demonstrated several times, students will now be doing a few labs on their own. Have students read the question and record hypotheses. They are to read the materials and procedures on their own and record results and conclusions when finished. Basically in this lab, students drop both a golf ball and a ping pong ball from the same height and see which will land first. Naturally, the golf ball will hit the ground first because it is heavier and has more gravity pulling it down. Explain that mass is similar to weight, but is slightly different because weight takes gravity into consideration. Explain that if the two balls were compared in space, it would be difficult to determine, because they would both be weightless due to the absence in gravity. Mass, refers to the amount of matter packed into an object. Also give the example of stubbing a toe against a book vs. a brick of the same size. Hitting the brick would be much more painful because the cement contains much more matter inside it, causing it to have more mass. (Tell students for now weight and mass can be used interchangeably; however, it is important to know there is a slight difference in terminology.)

15. Remind students of the Floating Boat experiment. Explain that this experiment also showed the principle of density. Tell students that at first the clay sank because it was denser than the water. When the clay boat was formed by changing the boat's volume, its weight was spread out and it became less dense than the water, allowing it to float. Use one of the golf and ping-pong balls from the previous experiment. Place one at a time in a glass of water. Students should notice that the golf ball sinks because it is denser than the ping-pong ball. When an object is denser than water, it will sink.

16. Write the definition for density on the board. Let students know that an easy way to think of it is the thickness of the molecules. If the molecules are tightly packed together (like students were in the states of matter Water in the Jar activity) the object is very dense. Make two columns on the board: dense and not dense. Brainstorm materials that would fall under each category. Some dense items might include stone, iron, and lead. Items that are not dense would include styrofoam, wood, and cork.

17. **Liquid Layers Demonstration**. Demonstrate to students that different liquids have densities, therefore settling in different places in a glass. First pour some corn syrup in a glass, then cooking oil. Finally pour in some water. Explain that

the corn syrup sunk to the bottom because it has the greatest density. The water is denser than the oil, but less dense than the corn syrup.

18. **Floating Eggs-periment**. Hand out Appendix F: Floating Eggs-periment. Have students pair up with a partner for this activity. Have partners read over the question and formulate a hypothesis. Next, they are to read the materials and the procedure. Finally they will record results and conclusions on their sheets. Discuss experiment results as a whole class. In this activity, students were to discover which water an egg would more easily float in, tap water or salt water. Students should have found the egg floated when enough salt was added to the water. An egg is denser than tap water and sinks in it. However, if enough salt is present in water it will become denser than the egg, causing the egg to float. (Note: Try this same experiment with a carrot slice instead of the egg. Results should be the same. A second time, a larger carrot piece should be used. Point out that the density remains the same even with a larger carrot piece, because the type of substance remains the same and density depends on the type of substance, not the amount of the substance.) A fun fact to share with students is that because the water in the Dead Sea is so dense with all the salt in it, a person can float effortlessly in it (their body is less dense than the salty water).
19. Briefly review definitions and differences of vacuum, volume, mass, and density.

E. *Assessment/Evaluation*
1. Students will list the three states of matter and illustrate an example of each.
2. Students will define matter's properties including mass, volume, density, and vacuum, and write one-two sentences for each, describing a classroom experiment that was performed and why it is an example of this property.

Lesson Three: Elements and Compounds (two days)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)
   b. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)
2. Lesson Content
   a. Elements are the basic kinds of matter, of which there are a little more than one hundred. There are many different kinds of atoms, but an element has only one kind of atom. Familiar elements, such as gold, copper, aluminum, oxygen, iron. Most things are made up of a combination of elements.
   b. Scientists have developed models of atoms; while these models have changed over time as scientists make new discoveries, the models help us imagine what we cannot see.
3. Skill Objective(s)
   a. Students will familiarize themselves with several elements of the periodic table including gold, copper, aluminum, oxygen, and iron.
   b. Students will apply their cognition of the periodic table in creating their own atomic model of an assigned element in which they will include the element name, symbol, atomic number and weight, and the correct number of protons, neutrons, and electrons.

B. *Materials*
1. *The Way Science Works* p. 47, by Robin Kerrod and Dr. Sharon Ann Holgate

2. *Investigations in Science: Chemistry* p. 18, by Phil Parratore
3. Appendix G: Building an Atom Model (one copy per student)
4. Model Atom Materials:
    a. two bags colored marshmallows separated into baggies according to color
    b. two small boxes of toothpicks (100 count ea.)
    c. ball of string or yarn
    d. plain white index cards (one per pair of students)
    e. large white construction paper (one sheet per pair of students)
    f. glue (one bottle or glue stick per pair of students)
5. Molecule Building Station:
    a. two boxes of toothpicks (100 count ea.)
    b. one bag colored marshmallows separated into baggies according to color
    c. two boxes of gumdrops separated into baggies according to color

C. *Key Vocabulary*
1. Element – simple substances made up of atoms with the same atomic number; the building blocks of matter
2. Compound – substance that is made up of the atoms of more than one chemical element
3. Periodic table of elements – simple chart displaying all the chemical elements; arrangement brings out relationships between elements
4. Group – column of elements going down the periodic table
5. Period – row going across the periodic table
6. Atomic number – number of protons in the nucleus of an atom

D. *Procedures/Activities*
1. Ask students if they remember where the word "chemistry" comes from. They may remember from Appendix A that it comes form the Arabic word meaning alchemy. Briefly give a little information of early alchemy of the Middle Ages (using Appendix A if necessary). Inform students that symbols were first used for the elements that related to astrological signs in order to keep their information secret from others. Since those days, we now use one or two letter symbols derived from the element name and do not keep this information secret anymore. In fact, there is a widely used table arrangements displaying all of this information for everyone to see. This table is called the Periodic Table of Elements. It was developed in 1869 by a Russian chemist, Dmitry Mendeleyev, who arranged the elements according to relative atomic mass, leaving gaps where he felt elements should go that were not yet discovered. Since then, the table has remained relatively in tact; however, the elements are now arranged in order of atomic number and most of the gaps have been filled with new element discoveries.
2. Using a periodic table, such as the one on p.47 of *The Way Science Works*, read off several common element names students should be familiar with and see if they can guess what the symbol is. Elements students should have heard of include sulfur, iron, nickel, copper, zinc, silver, aluminum, gold, lead, hydrogen, oxygen, nitrogen, and carbon. See if students can guess any other element names from the table without looking. List all these element names along with correctly guessed symbols on the board. Then add the rest of the corresponding symbols on the board.
3. Hand out a copy of the periodic table. A good copy of one can be found in *Investigations in Science: Chemistry* p. 18. (Most teacher resource books or children's chemistry books will have a copy of one of these included inside.)

Show students how the color-coded copy from p. 47 of *The Way Science Works* shows groupings of elements according to their major substance type such as metal, metalloid, or gas. Have students color their charts accordingly. Next, chose ten of the elements listed on the board for them to circle including aluminum, gold, copper, oxygen, and iron. These are the elements students will need to study and remember for their quiz at the end of the lesson. Review these element names along with their symbols several times.

4. **Building an Atom Model:** Pair students up with partners. Each group of two students will need to select an element with atomic numbers between 1 and 25. Make sure each pair in the room has a different element. Next, hand out Appendix G: Building an Atom Model. Let students know that they will be using the information on the periodic table to create their atoms.
5. First hand out a plain index card to each group. Have them copy down the periodic table information of their element onto their card including element name and symbol, atomic number, and relative atomic mass. Give them just a little additional information about atom construction before letting them read their experiment forms. Tell them that the atomic number is the number of protons in the atom's nucleus. This will be the same as the number of electrons there is orbiting around the atom. Sometimes the number of neutrons will vary and not match up to the number of protons in the nucleus, but for this activity they will. Ex: atomic number for helium is 2: 2 protons and 2 neutrons are in the nucleus, and 2 electrons orbit around the outside. Ask pairs to locate their atomic number on their index card. On the back of their card they first need to write both their names. Then they are to write how many protons, neutrons, and electrons their atom has. For our intents and purposes, they should all be the same number- the atomic number.
6. Next, tell students that each atom will have shells around the nucleus, the amount of shells will depend on their atomic number. Tell them that the first shell will hold up to two electrons, the second up to eight, the third up to eighteen, and the fourth thirty-two. Since all atomic numbers assigned to pairs in this activity are between 1 and 25, no more than three rings will be needed. Demonstrate several examples of electron arrangements on the board. After at least three examples are shown, have students draw on the back of their index cards a nucleus and several rings. Have them place the electrons on their rings according to their atomic number. Check students' work before moving on. This would be a great place to have a few other student helpers check other pairs' work. Only go on to the next step when partners have this process complete and correct.
7. Now vote as a class what color marshmallow will represent protons, neutrons, and electrons (only let them chose from the colors present in a bag of colored miniature marshmallows). Once this decision is made, write on the board which colors equal which atom particles. At this point, check that pairs have correctly followed the directions for their index cards. Once everyone has done so, let them begin their activity according to directions on Appendix G and beginning distributing supplies to those ready. (Note: For this activity to run smoothly, separate marshmallows into separate baggies ahead of time. Also plan to have a few parent helpers available. The project can be done without extra help, but goes much more smoothly and quickly with the extra hands.) Once complete, review results and conclusions from the experiment form (Appendix G) and display atom models either on the wall or hung from the ceiling.
8. **Molecule Building Station**: Have this activity available in conjunction with the atom models for those who finish early. Tell students that in their atoms they

only used one element. Here they will be constructing either a molecule or a compound. Tell students that a molecule is two or more atoms of the same element that are held together. Define a compound as atoms or molecules of two or more different elements joined together. Post a list on either chart paper or a small whiteboard of common molecules or compounds. Also include a key for which color marshmallows different elements represent. Students are to use the chart to build their compound or molecule with toothpicks and correct color marshmallows. Below is a list of compound and molecules to use:

Vitamin C= $C_6H_8O_6$	Ammonia= NH_3
Sulfuric Acid= H_2SO_4	Glucose= $C_6H_{12}O_6$
Water= H_2O	Hydrogen Peroxide= H_2O_2
Oxygen= O_2	Hydrogen Gas= H_2
Ozone= O_3	Sodium Chloride= NaCl (table salt)
Carbon Dioxide= CO_2	
Methane= CH_4	Baking Soda= $NaHCO_3$
Sucrose= $C_{12}H_{22}O_{11}$ (cane sugar)	Aspirin= $C_9H_8O_4$

The elements used in this list were C, H, O, S, N, Na, and Cl. A separate color marshmallow needs to represent each. If you do not have enough marshmallow colors, you may also use gumdrops.

E. *Assessment/Evaluation*
   1. Students will take a quiz on ten common elements and their symbols from the periodic table including gold, copper, aluminum, oxygen, iron, and others.
   2. Students will construct a model of the atom using paper, marshmallows, and toothpicks, properly placing protons and neutrons in the nucleus, with electrons on the appropriate surrounding shells. They will also need to include the element name along with its atomic number, weight, and symbol.

Lesson Four: Concentration and Saturation (one day)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)
      b. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)
   2. Lesson Content
      a. Concentration and saturation (as demonstrated through simple experiments with crystallization)
   3. Skill Objective(s)
      a. Students will experiment with different concentrations of sugar and salt to make a crystallized substance, which will represent how different crystals form in nature.

B. *Materials*
   1. Appendix H: Salt Crystals (half of a class set)
   2. Appendix I: Rock Candy (half of a class set)

C. *Key Vocabulary*
   1. Concentration – closely packed together
   2. Saturation – solution where no more of a substance can be dissolved into
   3. Crystallization – substance forms a solid in which the particles fit together in a regular pattern (crystal)

D. *Procedures/Activities*

1. (Note: Aside from a short discussion, this activity is completely self-directed for students. They will have a choice of one of two experiments to complete at home. Therefore, no experiment materials are necessary; however, you may wish to have some essentials available for those who need extra home assistance.)
2. Ask students if they have seen crystals anywhere in nature. Most students have and will give several good examples. Tell them that they will be performing an experiment where they will grow a crystal. Ask them if they have any idea on what makes a crystal grow. (You may even wish to have a few available for students to look at and pass around the classroom. If you do not have any or access to any, pick up a few books on crystals and show several of the pictures. Point out traits that different crystals have, including a specific repeating pattern. Explain that each type of crystal has its atoms arranged in a particular pattern that repeats over and over to form the whole solid. The patterns and numbers of atoms in them, differ depending on the crystalline substance.
3. Tell students that they will see in their experiment an example of these repeating patterns. The experiments both rely on the same principles, but one uses sugar and the other salt. Ask for a show of hands of whom wants the experiment using salt. Hand out Appendix H: Salt Crystals to those students. Give the remaining students a copy of Appendix I: Rock Candy.
4. Let students know this experiment will take about a week to see sufficient results. By this time they will need to have their lab sheets complete (either Appendix H or I), be prepared to present their crystals to the class including items explained in the assessment below. (Remember to set aside some class time 1- 1½ weeks from the time this project is assigned for crystal presentations.)
5. After students have presented their crystals and discussed conclusions, add just a little more information. Tell them that when the sugar or salt dissolved in water, the water molecules caused the sugar/salt molecules to break away from each other. As the water cooled, the large number of sugar or salt molecules were again attracted to each other. They packed close together in a specific pattern. Grains of sugar and salt on the string acted like “seed crystals,” a starting place for the crystals to grow. Crystals can grow without these seed crystals, but it takes much longer. Crystals such as these can be found many places in nature- in snowflakes and in most of the earth’s minerals. During Earth’s creation, many materials were so hot they melted, and when the rock solution cooled, the minerals crystallized.

E. *Assessment/Evaluation*

1. Students will choose one of two crystal formation experiments to perform at home using the scientific process. Once formed, students will present their crystals to the class, including in their explanation how much concentrated sugar or salt they used to reach saturation, how long their crystal took to grow, and what conclusions they drew from this experiment on how crystals form in nature.

Lesson Five: Solutions and Mixtures (two days)

A. *Daily Objectives*

1. Concept Objective(s)
    a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)

b. Students will know and understand common properties, forms, and changes in matter and energy. (Colorado State Science Standard #2)

2. Lesson Content
   a. A solution is formed when a substance (the solute) is dissolved in another substance (the solvent), such as when sugar or salt is dissolved in water; the dissolved substance is present in the solution even though you cannot see it.
3. Skill Objective(s)
   a. Students will differentiate between the solvent and solute upon creating a variety of solutions.
   b. Students will determine causes for variations in dissolving time including heat and particle size.

B. *Materials*
1. Dissolving Demonstration Materials:
   a. six test tubes
   b. six sugar cubes
   c. one baggie
   d. hot water
   e. cold water
2. Solution Samples Materials:
   a. four baby food jars with lids
   b. hot water
   c. cold water
   d. one teaspoon of each: cooking oil, corn syrup, sand, baking soda
3. Assessment Materials:
   a. one pre-made pitcher of Kool-Aid (more if not enough for whole class)
   b. bag of sugar
   c. unopened Kool-Aid packet
   d. bowl of water

C. *Key Vocabulary*
1. Mixture – substance that contains two or more different elements or compounds mixed together but not combined chemically
2. Solution – special kind of mixture in which a gas, solid, or liquid is dissolved in a liquid
3. Solute – substance that dissolves in a liquid to form a solution
4. Solvent – liquid that dissolves substances to form a solution
5. Soluble – substance that dissolves in water
6. Insoluble – substance that does not dissolve in water
7. Solubility – amount of solute that will completely dissolve in a given amount of solvent

D. *Procedures/Activities*
1. Ask students what kind of drinks they have had where something had to be dissolved. (Ex: hot chocolate, lemonade, etc.) Tell them that in this demonstration they will need to determine what causes items to dissolve faster.
2. **Dissolving Demonstration**: Place one sugar cube in a baggie and crush it. Then pour out the pieces into one of the test tubes. Place a whole sugar cube in a different test tube. Next, fill each test tube half full of water and shake them until one of the test tube's sugar has completely dissolved. Record on the board which dissolved first, the crushed or whole sugar.
3. Now crush two more sugar cubes in the baggie, placing one in at a time and pouring the pieces into two new test tubes. Fill them with the same amount and

temperature of water and shake only one of them. Again record results of which test tube's sugar dissolved first, the shaken or unshaken.

4. Finally, crush two more sugar cubes one at a time in the baggie and pour each into two new test tubes. Add hot water to one and the same amount of cold water to the other. Record on the board which test tube's sugar dissolved first, the one with hot or cold water.
5. Discuss the results on the board and conclude that certain factors can be added to dissolve particles faster into a solution such as heat, particle size, and shaking.
6. Refer back to the dissolving demonstration and review the three things that caused the sugar to dissolve quicker. Tell students that they will see a similar demonstration now dealing with solutions. However, first they need to be quite familiar with solution terms. Define on the board solution, solvent, solute, solubility, and insolubility. Beside the definitions give an example of each. For solvent, solute, and solution use items from the previous demonstration. The solution would be sugar water, the solvent hot and cold water, and the solute was the sugar cube. Brainstorm together an example of something soluble and insoluble. Let students know that in this next demonstration, they will need to identify which item is the solution, solvent, or solute, and will need to conclude if the solute is soluble or insoluble.
7. **Solution Samples**: Place a spoonful of each cooking oil, corn syrup, sand, and baking soda into separate baby food jars. Fill each jar half full of water, seal the lids tightly, and shake them vigorously. Hold up the jars one at a time to determine which items dissolved and which did not. Write these results on the board. Now go through and identify the solution, solvent, and solute for each one. Write the results on the board. The corn syrup and baking soda should dissolve, the others will not. The four solutes should be the corn syrup, baking soda, oil, and sand. The solvent in all these cases was the water.
8. As a follow-up discuss that many substances are water soluble, but not all. Brainstorm other items that are or are not water-soluble. Explain cases where you would want substances that are not soluble in water. (Ex: paint on a house, grass, clothing, etc.)
9. The assessment is one that most likely no student will mind doing. Place a pitcher of pre-made Kool-Aid, along with a bowl of water, a bag of sugar, and an unopened Kool-Aid package on a table where all students can see. Have them write the words solution, solvent, and solute on their papers in a column. Next to the words they are to write down which item from the table is an example of each. Underneath this, they are to explain in one-two sentences at least two factors that could speed up the dissolving process when making Kool-Aid.
10. Explain that once a solution is created, the original ingredients are difficult to separate because a new substance if formed. In contrast, a mixture has different ingredients (substances) in it, but they keep their original properties. For example, in a cinnamon-sugar mixture to spread on toast, a new flavor is created, although you can still clearly taste and see both substances. It would be possible (although time consuming) to separate out the two different ingredients. Spend just a few extra minutes differentiating between a mixture and a solution by listing other mixture examples vs. solution samples.

E. *Assessment/Evaluation*

1. Students will look at a solution (Kool-Aid) along with its ingredients and record which are the solution, solvent, and solute. They will also include a sentence explaining at least two factors that could speed up the dissolving process in this solution.

VI. CULMINATING ACTIVITY (two days)

A. **Culminating Quiz**: Review all major concepts studied throughout the unit soon after finishing Lesson Five. Have students compile their notes into a study guide in order to prepare for the culminating quiz. The day before the test, play a review "Tic-tac-toe" game. Fold up strips of papers with a number 1-9 on each of them and put them in a hat. Divide the class into two teams: the Xs and the Os. Take turns pulling out a strip of paper for each team. Then ask the team whose turn is up a review question. When a team answers a question correctly place their symbol (either X or O) in the square that corresponds with the number that was pulled out of the hat at the beginning of their turn. The turn always goes to the next team after the other team answers a question, whether they answer it correctly or not. Play ends when a team gets three of their symbols in a straight line, making a tic-tac-toe. Continue to repeat if more review is needed or as time allows. Have students complete the culminating unit quiz (Appendix J) the next day. Appendix K is included as an answer key.

B. **Solution Stations**: Select four different solution experiments, which were not included in the unit that students would have a lot of fun with. Arrange for parent volunteers to help with this activity ahead of time. Ideally you want one adult per station because the super fun experiments are extremely messy. *Icky Sticky Foamy Slimy Ooey Gooey Chemistry* by Kristine Petterson is an outstanding resource for this, full of easy-to-follow simple, but fun and messy chemistry experiments. Student-recommended activities from the book include "Lucky Loogie Goop," "Toe Cheese Goop," "Greasy, Grimy Gopher Guts," and "Wounded Arm." Janice VanCleave's *Chemistry for Every Kid* also has several activities that would work well at stations including "Floating Spheres," "Naked Egg," "The Green Blob," and "Floating Sticks." A great way to minimize materials expenses for these stations is to assign groups ahead of time, appointing a captain for each group. (Each station will most likely have two groups at a time in order to keep group numbers small.) The captain will be responsible for bringing items such as measuring cups and spoons, a mixing bowl and spoon, along with two or three other supplies they are likely to have at home. On the day of the solution stations, ask students to wear a paint shirt (or large old T-shirt) over their clothes. Have groups rotate through the stations until they have participated in all four activities.

VII. HANDOUTS/WORKSHEETS

A. Appendix A: Introducing Chemistry
B. Appendix B: Reviewing Atoms and Molecules
C. Appendix C: Scientific Process Experiment Form
D. Appendix D: Volume of Juice Experiment
E. Appendix E: Which Will Drop First?
F. Appendix F: Floating Eggs-periment
G. Appendix G: Building an Atom Model
H. Appendix H: Salt Crystals
I. Appendix I: Rock Candy
J. Appendix J: Quiz
K. Appendix K: Quiz Answer Key

VIII. BIBLIOGRAPHY

A. Bosak, Susan V., Douglas A. Bosak, and Brian A. Puppa. *Science Is…* Ontario, Canada: Scholastic Canada Ltd., 1991. 0-590-74070-9.

B. Chisholm, Jane and Mary Johnson. *Introduction to Chemistry*. London, England: Usborne Publishing Ltd., 1983. 0-88110-1516.

C. Gallant, Roy A. *The ABC's of Chemistry: An Illustrated Dictionary*. Garden City, NY: Doubleday and Company, Inc., 1963.

D. Georges, Jason and Tracy Irons-Georges. *Rourke's World of Science Encyclopedia: Chemistry*. Vero Beach, FL: Rourke Corporation, Inc., 1999. 0-86593-482-7.

E. Hirsch Jr., E.D. *What Your Fourth Grader Needs to Know*. New York, NY: Dell Publishing, 1992. 0-385-31260-1.

F. Kerrod, Robin and Dr. Sharon Ann Holgate. *The Way Science Works*. New York, NY: DK Publishing, Inc., 2002. 0-7894-8562-1.

G. Knapp, Dr. Brian. *Science Matters! Volume 16: Changing from Solids to Liquids to Gases.* Danbury, CT: Grolier Educational, 2003. 0-7172-5850-5.

H. Lafferty, Peter. *Macmillan Encyclopedia of Science: Matter and Energy*. New York, NY: Macmillan Library Reference, 1991. 0-02-864557-X.

I. Oxlade, Chris. *Chemistry*. Austin, TX: Raintree Steck-Vaughn Publishers, 1999. 0-8172-4948-6.

J. Parratore, Phil M. *Investigations in Science: Chemistry*. Cypress, CA: Creative Teaching Press, Inc., 1995. CTP 2806.

K. Petterson, Kristine. *Icky Sticky Foamy Slimy Ooey Gooey Chemistry*. Pace Product, Inc., 1996. 1-880592-47-9.

L. VanCleave, Janice. *Chemistry for Every Kid*. New York: John Wiley and Sons, Inc., 0-471-62085-8.

Appendix A

Name ______________________#___
Date ______________________

INTRODUCING CHEMISTRY

Chemistry is the study of substances (or matter) and the changes that happen to them. Many things people use everyday—food, clothing, and medicine—come from a knowledge of chemistry. By studying what things are made of, and how they react with other things, chemists (people who study chemistry) can work out how to make new, useful substances. Examples of things chemists have invented or developed include plastics, fabrics such as nylon, rayon, and polyester, petrol for fuel, paints, glues, household cleaners, and cosmetics. When certain chemicals are put together they cause reactions. There are reactions happening all around you such as when you strike a match or wash the dishes. Rust on cars and buildings is a chemical reaction. Digesting food and breathing are also chemical reactions occurring inside the body all the time. Chemistry is everywhere!

Chemistry comes from the Arabic, *al quemia*, meaning alchemy. This was an early form of chemistry, which began in the Middle Ages. Alchemists began by trying to turn ordinary metals into gold. Astrological symbols were used by alchemists to keep their discoveries secret. There was often a lot of superstition and magic involved. Although it was not the specific science we have today, they did make many important discoveries such as making medicines and drugs from herbs. It wasn't until the 17th century when modern chemistry began, with Robert Boyle's definition of elements and John Dalton's atomic theory. Dalton said that elements could be divided into tiny particles called atoms. This idea provides the framework for modern chemistry.

Scientists believe that all substances (matter) are made up of particles. The tiniest particle is called an atom. It is the smallest particle that can have the chemical properties of a particular element. The atom is so tiny that it cannot be seen by the naked eye. In fact, an object needs to be magnified millions of times to be able to see its atoms. Each atom is like a mini solar system, because it has a nucleus in the middle with tiny particles called electrons orbiting around the outside, just like the planets orbit around the sun. Inside the nucleus are particles called protons and neutrons. There are equal numbers of protons, which have a positive electric charge, and neutrons, which have no electric charge, making them neutral. The electrons, which have a negative electric charge, orbit the nucleus at a great distance. Most of the space between the nucleus and the electrons is empty.

Electrons are very tiny and move around the nucleus of an atom in special layers called shells (electron shells). Each shell can have several electrons in it. Many atoms have several electron shells. Normal atoms have the same number of electrons and neutrons. All electrons have a negative electrical charge. The attraction between the negative electron and the positive proton is what holds the atom together.

Appendix B

Name ________________________#___
Date _________________________

REVIEWING ATOMS AND MOLECULES

1. What are atoms?

2. What is the size of an atom?

3. What are the names of the parts of an atom?

4. What are the charges each part has? Do they attract or repel?

Models of Atoms:

Inventor:	Dalton	Thomson	Rutherford	Bohr
Name:				
Year:				

Interesting Atomic Facts:

1.

2.

3.

4.

5.

Appendix C

Name ________________________#___
Date ________________________

SCIENTIFIC PROCESS EXPERIMENT FORM

Activity Title: ____

Question: (What do you want to find out?) ____

____

____

Hypothesis: (Predict what you will find out) ____

____

____

Materials: (List items you will need for this experiment) ____

____

____

____

Procedure: (List steps you will take to test your hypothesis)

1. ____
2. ____
3. ____
4. ____

Results: (What actually happened?) ____

____

____

Conclusion: (What did you learn from this experiment?) ____

____

____

Appendix D

Name _______________________#___
Date _______________________

VOLUME OF JUICE EXPERIMENT

Question: Which glass of juice has the most volume, the short, fat glass or the tall, narrow glass?

Hypothesis: ____

____

Materials: one carton of orange juice
one clear, short, fat glass
one clear, tall, narrow glass
clear liquid measuring container

Procedure:

1. Pour juice from short, fat glass into the measuring container.
2. Record the measurement under results.
3. Pour the liquid back into the short, fat glass.
4. Now pour juice from the tall, narrow glass into the measuring container.
5. Record the measurement under results.
6. Return the juice back to the tall narrow glass.

Results: (What actually happened?) ____

____

____

Conclusion:

Which glass contains the greater volume of juice? ____

____

____

Appendix E

Name ________________________#___
Date ________________________

WHICH WILL DROP FIRST?

Question: Which ball will hit the ground first, the Ping-Pong ball or the golf ball?

Hypothesis: ____

____

Materials per group: one Ping-Pong ball
one golf ball

Procedure:
1. Find an open area in the room for this experiment. Other groups will be dropping their balls too, and you do not want to get hurt or have your results interfered with.
2. Move a desk or table to that area. Choose one person in the group to sit on the desk, while the other members watch the floor for results.
3. The person sitting on the desk needs to hold both the golf ball and Ping-Pong ball over the edge of the desk and drop them at the same exact time from the same exact height.
4. The members watching the floor need to determine which hits the ground first and record this under results.
5. Choose a different group member to repeat the procedure, holding the balls up higher before dropping them.
6. Repeat the experiment several time, dropping balls from different heights, until all team members have had a turn. One of the times have a team member stand on the desk, dropping the balls from that height. Be sure to record the results each time.

Results: (What actually happened?) ____

____

____

Conclusion:

Which falls faster, the Ping-Pong ball or the golf ball? ______________________________

____

____

Appendix F

Name ______________________#___
Date ________________________

FLOATING EGGS-PERIMENT

Question: What will cause an egg to float in water?

Hypothesis: ____

____

Materials per group: one fresh egg
one large clear drinking glass
tap water
one half cup salt
one plastic spoon

Procedure:

1. Fill the drinking glass with tap water.
2. Carefully place an egg into the water. What happens to it? Does it float or sink? Record the results.
3. Stir salt into the water, one spoonful at a time. How much salt do you have to add before the egg floats up to the surface of the water? Record that amount.
4. Once the egg is floating, wash off the spoon, and add more water to the glass until it is almost full. Add the water slowly, dribbling it along the side of the glass with the clean spoon, so that the salt water and fresh water do not mix. The egg should be floating between the two water layers.
5. (Optional, if time allows) Repeat the steps with a small piece of carrot. Does it float like the egg? What if a larger piece of carrot is used instead? Try this and see if there is a difference.

Results: (What actually happened?) ____

____

____

Conclusion:

What kind of water did the egg float in, the fresh water or the salt water? ____________________

____

____

Appendix G, page 1

Name ______________________#___
Date ______________________

BUILDING AN ATOM MODEL

Question: How can a model represent an atom?

Hypothesis: ____

____

Materials per group: ___ _________ marshmallows for protons
___ _________ marshmallows for neutrons
___ _________ marshmallows for electrons
large sheet of white construction paper
one glue bottle or glue stick
ten toothpicks
one 12" piece of yarn or string
one plain white index card

Procedure:

1. Fill in under materials the number of marshmallows needed for each of the particles. Look at the back of your index card to help you. It should be the same as the atomic number.

2. Next, look at the board to fill in the color of marshmallow for each of the particles. Use the colors that the class agreed upon. Fill this in next to the marshmallow number under materials.

3. Gather together all necessary supplies that are listed above. Make sure to get your index card checked by your teacher before getting supplies.

4. Put your protons and neutrons into a clump. Attach them using the toothpicks. Get more toothpicks if necessary. If you have extras, please return them.

5. On the large construction paper draw an oval, so that the lines are close to the edge. Now draw two more ovals inside the larger one, so that there is about one inch between the rings. Look at your index card drawing to see if your atom has more than two rings. If so, draw one more oval inside the smallest one, again leaving about one inch between the rings. Cut out the rings when finished and throw the inside scrap away.

6. Begin by gluing your electron marshmallows on the inside ring; remember it can hold up to only two. Next, glue the rest of the marshmallows on the second ring. It can hold up to eight. If you still have electrons left over, glue them onto the third ring.

7. Tie string around the center of the nucleus marshmallow blob, making a tight knot. Now place it inside the smallest ring. Set the other rings around the smallest one, leaving even spaces between each ring.

Appendix G, page 2

8. Have one person hold the nucleus and rings down, while the other person ties the string around each piece. Be sure to tie secure knots. Then tie the end of the string through a hole in the bottom of the index card (make the hole with a pencil point). The final product should look like a mobile of rings with the nucleus in the center, and the card hanging at the top.

Results: (What actually happened?) ____

____

____

Conclusion:

How do the different model marts represent an atom? ____

____

____

Appendix H

Name ______________________#___
Date ________________________

SALT CRYSTALS

Question: Can a crystal form from salt and water?

Hypothesis: ____

____

Materials: 500 mL beaker or large container
two 250 mL beakers or containers
½ lb. Epsom salt
8"-10" thick string or thin rope
one plastic spoon
tap water

Procedure:

1. Fill the 500 mL beaker or large container with about 400 mL of water.
2. Slowly stir the Epsom salt into the water, dissolving as much of it as possible.
3. Fill each of the two 250 mL beakers about half full with the Epsom salt solution.
4. Place beakers side by side, 4-6 inches apart. Place each end of the string in one of the beakers, letting the string sag in between.
5. Let the two beakers and string stand undisturbed for a week. Record observations daily.

Results: (What actually happened?) ____

____

____

Conclusion:

Did the salt and water work together to form a crystal? How do you think this happened? ____________

____

____

Appendix I

Name ________________________#___
Date _________________________

ROCK CANDY

Question: Can a crystal form from sugar and water?

Hypothesis: ____

____

Materials: sugar
boiling water
clear plastic drinking glass
clean piece of string or thread
plastic spoon
pencil
clean paper clip
paper towel

Procedure:

1. Fill a drinking glass one-third full of boiling water.

2. Stir sugar into the water until no more can dissolve.

3. Tie one end of a piece of string to the middle of a pencil and the other end to a clean paper clip. Dampen both the string and paper clip and then dip them into dry sugar.

4. Place the pencil across the rim of the glass, so that the paper clip is suspended midway in the solution.

5. Put the glass where it won't be disturbed; cover it loosely with a paper towel to keep out dust.

Results: (What actually happened?)____

____

____

Conclusion:

Was a crystal formed from the sugar and water solution? How do you think this happened? ____________

____

____

Appendix J, page 1

Name ______________________#___
Date ________________________

CHEMISTRY UNIT QUIZ

MULTIPLE CHOICE: **Circle the *letter* of the answer that most accurately matches the question**.

1. What particles orbit the nucleus of an atom?
   a) isotopes
   b) protons
   c) neutrons
   d) electrons

2. The absence of matter is a:

   a) solid
   b) vacuum
   c) density
   d) mop

3. What is the name of the chart that Mendeleyev developed to organize all the elements?

   a) Atomic Number Table
   b) Element Chart
   c) Mendeleyev's Masterpiece
   d) Periodic Table of Elements

4. What is the name for a solid formed in nature, including most minerals, whose atoms have specific repeating patterns?

   a) wood
   b) gold
   c) crystals
   d) candy

5. Hot chocolate is an example of a:

   a) solvent
   b) solute
   c) solution
   d) saturation

MATCHING: **Match the particle with its charge by writing its *letter* in the blank**.

_____1. proton	A. neutral (0)
_____2. neutron	B. positive (+)
_____3. electron	C. negative (-)

Appendix J, page 2

<u>FILL IN THE BLANKS:</u> Complete the following sentences with a one or two word answer.

1. The center of an atom is called the ______________________.
2. The scientist's name who discovered the "electron shell" in 1913 is ______________________.
3. The Periodic Table arranges just over one hundred natural and manmade ____________________, of which all matter is made up.
4. When a solution can hold no more of a solute, it is said to be __________________________.
5. A substance that will not dissolve in water is __________________________.

<u>COMPLETE THE PHRASE:</u> Finish these phrases using either the word *attract* or *repel*.

1. Positive charges _____________________________.
2. Negative charges ____________________________.
3. Neutral charges _____________________________.

<u>SHORT ANSWER:</u> Please answer the following questions with *complete sentences*.

1. What is the size of an atom?
2. What is the difference between a molecule and a compound?
3. List six elements and their symbols from the Periodic Table.
4. What important discovery did Marie Curie and her husband make?
5. List at least two things that help a substance dissolve more quickly.
6. Name the three states of matter and list (or illustrate) at least two examples of each.

Appendix J, page 3

MATCHING: Match each of the following terms with its correct definition by writing its *letter* in the blank.

_____1. Volume   A. the absence of matter
_____2. Mass   B. amount of mass for a certain volume
_____3. Density   C. measure of the amount of matter in an object
_____4. Vacuum   D. amount of space taken up by matter

ESSAY QUESTION: Think back to all the experiments done throughout this unit. Choose one experiment to describe. Include the procedure followed, what you learned from this experiment, and why you liked it. Your paragraph must be at least five sentences written in cursive.

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

BONUS: For extra credit, choose another experiment to write an essay about, following the same procedure mentioned above. You may either attach your own paper or write on the back of this page.

Appendix K, page 1

Name ______________________#___
Date ________________________

CHEMISTRY UNIT QUIZ ANSWER KEY

MULTIPLE CHOICE: Circle **the *lette*r of the answer that most accurately matches the question**.

1. What particles orbit the nucleus of an atom?
   a) isotopes
   e) protons
   f) neutrons
   g) electrons

2. The absence of matter is a:

   e) solid
   f) vacuum
   g) density
   h) mop

3. What is the name of the chart that Mendeleyev developed to organize all the elements?

   e) Atomic Number Table
   f) Element Chart
   g) Mendeleyev's Masterpiece
   h) Periodic Table of Elements

4. What is the name for a solid formed in nature, including most minerals, whose atoms have specific repeating patterns?

   e) wood
   f) gold
   g) crystals
   h) candy

5. Hot chocolate is an example of a:

   e) solvent
   f) solute
   g) solution
   h) saturation

MATCHING: **Match the particle with its charge by writing its *letter* in the blank**.

__**B**__1. proton	A. neutral (0)
__**A**__2. neutron	B. positive (+)
__**C**__3. electron	C. negative (-)

Appendix K, page 2

FILL IN THE BLANKS: Complete **the following sentences with a one or two word answer.**

1. The center of an atom is called the ______**nucleus**_________.

2. The scientist's name who discovered the "electron shell" in 1913 is ____**Niels Bo**hr_________.

3. The Periodic Table arranges just over one hundred natural and manmade _____**elements**_______, of which all matter is made up.

4. When a solution can hold no more of a solute, it is said to be ______**saturated**___________.

5. A substance that will not dissolve in water is ___**insoluble**______________.

COMPLETE THE PHRASE: Finish **these phrases using either the word** ***attract*** **or** ***repel***.

1. Positive charges ________ **repel**______________.

2. Negative charges ________**attract**_____________.

3. Neutral charges ________**attract**_____________.

SHORT ANSWER: **Please answer the following questions with** ***complete sentences*****.**

1. What is the size of an atom?

An atom is the smallest unit of a chemical element. Atoms are too small to be seen with the naked eye. They can only be seen under microscope after magnifying them by thousands.

2. What is the difference between a molecule and a compound?

A molecule is the smallest particle of a compound, which can normally exist by itself and still have the properties of that substance. A compound is a substance that is made up of the atoms of more than one chemical element.

3. List six elements and their symbols from the Periodic Table.

Answers will vary. Some examples include gold (Au), copper (Cu), aluminum (Al), oxygen (O), Hydrogen (H), and iron (Fe).

4. What important discovery did Marie Curie and her husband make?

Marie Curie and her husband discovered radium and its radioactive qualities. This was important because this radioactivity can be used to kill cancer cells.

5. List at least two things that help a substance dissolve more quickly.

Substances dissolve quicker when particle size is small, heat is added, and the solution is shaken.

6. Name the three states of matter and list (or illustrate) at least two examples of each.

The three states of matter include solid, liquid, and gas. Examples of each will vary.

Appendix K, page 3

MATCHING: Match each of the following terms with its correct definition by writing its *letter* in the blank.

__**D**__1. Volume	A. the absence of matter
__**C**__2. Mass	B. amount of mass for a certain volume
__**B**__3. Density	C. measure of the amount of matter in an object
__**A**__4. Vacuum	D. amount of space taken up by matter

ESSAY QUESTION: Think back to all the experiments done throughout this unit. Choose one experiment to describe. Include the procedure followed, what you learned from this experiment, and why you liked it. Your paragraph must be at least five sentences written in cursive.

Answers will vary. Check to make sure five sentences are included and that sentences are written in cursive.

BONUS: For extra credit, choose another experiment to write an essay about, following the same procedure mentioned above. You may either attach your own paper or write on the back of this page.

Answers will vary. Check to make sure five sentences are included and that sentences are written in cursive.