Chemistry Detectives!!!

Kharma Banks

When I was young and in elementary school, I had dreams of being able to conduct experiments and find a cure for some sickness or being able to build some type of contraption that would make life easier for me or for others. My interest in these subjects came because someone exposed me to science experiments from a young age. Now, nothing ever came from my experiments, but, I felt as though I was a scientist and I could try to use my science for good. I experimented with mixing all kinds of goo and gooky substances, such as dish washing liquid and soap, or salt or sugar and glue or other liquids. I mixed whatever I could get my hands on and now as an adult, I understand that the things that I was putting together back then would not have done anything for anyone as far as being a positive contribution to the world of medicine. As a child, though, I was not afraid to try things because I was empowered to feel that anyone, including me, could make a positive contribution to society. I would like to make sure that the students I teach develop an appreciation for science and understand certain concepts (whether they aspire to become a scientist or not) at a developmentally appropriate pace so that if they decide they want to take their science to the next level one day, they will feel empowered and knowledgeable enough to work towards that goal. The thing that I make sure to communicate to my students now is that they should feel free to experiment with adult supervision. **All items that children can get their hands on should be approved by a parent or a teacher and provided in an environment where they are supervised but allowed to try their experiments safely**.

Second grade students in North Carolina study the states of matter and changes in the states of matter. They typically enjoy the hands-on experiments that they are able to experience while continuing their scientific learning. I originally had the idea of having the students make a "recipe book" for a chemist where they would write "How-to" stories about the various experiments they would complete in the classroom. After being in seminar and interacting with other science teachers, I decided to change my idea.

I have prepared a mystery-solving experience for the students where they will need to use properties of matter, states of matter, or reactions to solve it. Children in second grade are seven and eight years old and they are very inquisitive students that are ready to explore the world around them. I have been teaching for seven full years (currently in my eighth year) and science is something that most students absolutely love to do! It provides them with hands-on experiences and meets the needs of many types of learners. The students would be extremely motivated to solve a mystery that keeps them engaged to make them feel like detectives. This idea is solidified by my experience at the end of last school year when my grade level had "Professional Day" with the second graders at

my previous school. One of my students dressed up and brought business cards that said he was a detective and he handed those business cards out and most of the students thought his was the neatest job. They decided that they might want to be a detective when they grow up as well. I will provide an experience that should excite future second graders as these students have been excited. If students are motivated, then I believe that the unit will be a successful one and they will be more likely to retain their learning.

The school where I currently am serving is John Motley Morehead STEM Academy in Charlotte, NC. We are the district magnet school for Science, Technology, Engineering, and Math (STEM) and have kindergarten through seventh grades currently enrolled. Next year, we will expand to having eighth grade classes. The school population consists of about 800 students. There are 525 African American students (65.7%), 53 White students (6.6%), 34 Asian students (4.3%), 146 Hispanic students (18.3%), 12 American Indian students (1.5%), and 29 Multi-Racial students (3.6%). There are 342 female students (42.8%) and 457 male students (57.2%). 7.8% of the population consists of Limited English Proficient students, and only 2.8% of the students are those with disabilities. The second grade classes here have about 24 students each. Our school expects that all lesson plans will have a STEM connection to ensure that we meet our magnet expectations. The school-wide goals are to ensure that 90% of the students demonstrate proficiency on End of Grade Assessments and that all students show a year and a half worth of growth. The staff at our school now wears buttons daily to represent our goals that say, "90/.15." This serves as the daily reminder of where we are headed and what we want our students to show by the end of the year.

Background

"Chemistry as a subject is taught by means of models. Indeed, science can be understood as largely concerned with developing models of aspects of the natural world. Scientific models evolve through the processes of scientific enquiry and discourse, and may be sophisticated and highly abstract" (1).

In order to prepare for this unit, I had to research the science behind chemical reactions. According to my seminar leader, Banita Brown, chemical reactions are key in the life of science as reactants (substances) interacting with each other create a product (different substance). Some signs of chemical changes occurring are if you notice an odor change, color change, temperature change, gas formation (bubbling), solid formation (precipitate), and light formation (glowing), among others. Examples of chemical reactions include making soap, iodine and aluminum reactions, a sulfuric acid and table sugar reaction that give off heat as it creates carbon, and a crushed aspirin tablet mixed with methanol to create a Wintergreen fragrance as it is decomposing.

To clarify some of the basics, I needed to make sure I had accurate working definitions that I can explain to others of several of the vocabulary terms used throughout

this unit. I used the website http://dictionary.com (2) in order to find these working definitions. First of all, I looked up the molecule. Molecules are "the smallest physical unit of an element or compound, consisting of one or more like atoms in an element and two or more different atoms in a compound." Atoms are "the smallest component of an element having the chemical properties of the element, consisting of a nucleus containing combinations of neutrons and protons and one or more electrons bound to the nucleus by electrical attraction; the number of protons determines the identity of the element."

The structure of atoms is shown through the use of Bohr's Model as described on Jefferson's Question and Answer page. This site goes through the procedure for building an atom while discussing the nucleus, protons, electrons, and the stages of the model from the Planetary Model to the Bohr Model to the Refined Bohr Model which goes all the way down to the sub-shells of the atom (3).

Content Objectives

Prior to completing this unit, the students should have already received instruction and experiences so they have a solid understanding of what solids, liquids, and gases are. They should understand that if you change the temperature, the states of matter will change. During this unit, the students will be expected to use those terms with ease during their conversation and those terms will be used within the directions and discussions. This unit will challenge and extend student learning on this topic. The North Carolina Essential Standards for Matter, Properties, and Change in second grade state:

2.P.2 Understand properties of solids and liquids and the changes they undergo.
2.P.2.1 Give examples of matter that change from a solid to a liquid and from a liquid to a solid by heating and cooling.

2.P.2.2 Compare the amount (volume and weight) of water in a container before and after freezing.

2.P.2.3 Compare what happens to water left in an open container over time as to water left in a closed container. (4)

The North Carolina Standard Course of Study for second grade states:

Objective 3.01

Identify three states of matter:

- Solid.
- Liquid.

- Gas.

Objective 3.02

Observe changes in state due to heating and cooling of common materials.

Objective 3.03

Explain how heat is produced and can move from one material or object to another.

Objective 3.04

Show that solids, liquids and gases can be characterized by their properties.

Objective 3.05

Investigate and observe how mixtures can be made by combining solids, liquids or gases and how they can be separated again.

Objective 3.06

Observe that a new material is made by combining two or more materials with properties different from the original material. (5)

Teaching Strategies

Throughout this unit, I will incorporate hands-on experiences, Problem-Based Learning (PBL) experiences, and I will use the Socratic Seminar as a means for higher-level discussion. I believe that students should have access to hands-on experiences in all subjects, especially science. I read a California study about the effects of textbook lessons in science versus the hands-on learning approach. "Major ideas expressed by these teachers include that there is not enough emphasis on science in the classroom. Both teachers and students enjoy doing science in the classroom. All teachers felt that hands-on and exploration were the right way to teach science to elementary students. Finally, they felt that with pre and post lessons, field trips can be very beneficial to students." (6) In addition, "The research literature indicates that teachers need a variety of methods in teaching science. Teachers who participated in this study stated a strong preference for using hands-on activities in science, especially given the limited amount of time for science in the current curriculum." (7)

PBL as an inquiry-based learning strategy, is characterized by its encouragement of collaborative group work; an emphasis on analysis, evaluation and focus on reflection as integral components of practice. (8) Students work in groups to solve real-world problems or figure out solutions using technology and other active learning mediums,

but, the students work together to develop a plan for solving. In this case, it will be a simulated experience. The teacher provides access to resources that students may want to use and acts as a facilitator of learning.

"Another strategy that I will use in this unit is the Socratic Seminar. After researching this, I have learned that it is an excellent way to get students discussing concerns and issues while treating each other with respect. This type of seminar teaches them how to interact with others when you agree and when you disagree. According to the National Paideia Center, Socratic seminar is a "…structured, formal discussion that requires critical thinking, and focuses on texts related to ambiguous issues and values." (9) The center website also has a video of how students benefit from this type of interaction at http://www.paideia.org/for-teachers/. Students must have some sort of text that they are addressing with this dialogue. The classroom must be set up in a way that all children can see each other because they must be able to look at each other in the eye when speaking to each other. For example, they should sit with desks in a circle or chairs should be arranged in a circle. There should also be norms in place so that all students know the expected respectful behaviors that they will need to display in order to participate. Lastly, the teacher must have at least one guiding question for the children to discuss. As they discuss, the teacher should guide discussion if it needs guidance, but the purpose is for students to critically think and lead the discussion. They learn how to ask relevant questions and participate within a whole group without much guidance and facilitation from the teacher. There is a video on You Tube that describes this type of seminar and gives clips of examples with labels of how that seminar follows the criteria of being a Socratic seminar. It can be viewed at http://www.youtube.com/watch?v=QxZMGK6IdEs". The video lasts about six minutes and is an excellent way to observe how a seminar should run. There are older children in this particular group, but, all components are able to be used with elementary students." (10)

Classroom Activities

I will act as a secret agent giving my students a mission to begin the unit. They will receive "undercover experiments" to complete in order to help them solve the mystery. They will answer a question at the end of each experiment and will take the first or last letter of each answer from each experiment and use those letters as a secret message to figure out what a person is called that solves mysteries (See Resource #3). I also figured out where to incorporate something to expose students to the periodic table since I have learned from the high school teacher fellows in my seminar that they wish students had more exposure to the periodic table of elements in the lower grades.

Each lesson begins with a quick class experiment and writing activity (such as the lava lamp experiment that we did in our seminar or the experiment with the three levels of

liquids that do not overlap within a container) so that students are motivated and excited about each lesson. This will open up the interest in the content and the teacher is able to model appropriate handling of materials during an experiment. The teacher can also model wearing goggles and model thinking about and recording experimental data during these times. Students will record the answer to a question or respond to a prompt regarding the experiment, discuss it and then move into each lesson. The prompts will include, but are not limited to: What did you observe during the experiment? What states of matter were evident within the experiment? Why do you think _____ happened during the experiment? These will be quick prompts where students spend about 5 minutes jotting down their thoughts, ideas, and predictions. Afterwards, or at a later point in the day, we will use the Socratic Seminar method to discuss the observations and thoughts about the experiment.

1. Experiment 1—Create a lava lamp (Materials: graduated cylinder, 80 mL of water, food coloring, 10 mL of vegetable oil, table salt)

   For this whole-class experiment, have the students take turns doing the following or watch the teacher do the experiment before recording. Pour 80 mL of water into a graduated cylinder. Drop a few drops of any color food coloring. Add 10 mL of vegetable oil. Top it off by pouring in some table salt. Watch the salt interact with the oil creating blobs that sink to the bottom and then float from the bottom to the top. More salt may be added if the blobs slow down from the salt dissolving in the water.

   Explanation of what is happening: "At first, the oil floats on the water because it's lighter--or, more accurately, it's less dense than the water. It also doesn't mix with water, so it won't dissolve. The salt, however, is denser than the water and does dissolve. When you shake it onto the oil, it clings and drags a glob of oil through the water to the bottom of the cylinder. In time, however, the salt starts to dissolve in the water. At a certain point, it can no longer hold down the oil blob, which then floats back up to the surface" (11).

2. Experiment 2—Intermolecular Forces (Materials: graduated cylinder or clear glass jars/cups, pentane, water, methylene chloride, food coloring, iodine)

   For this whole class experiment, the teacher should do all parts while students observe. Pour some methylene chloride into the graduated cylinder or clear glass container. Pour water into the container mixed with food coloring (blue is recommended, but, any color will do). Mix pentane and iodine together (a purple color results) and pour into the container. (A variation of materials would be to use oil, water, and syrup in the glass container for the same reaction.) Watch the water separate the pentane/iodine from the methylene chloride and show three sections of liquid that will not mix.

Explanation of what is happening: Polar molecules attract each other and do not mix with non-polar molecules. Water is a polar molecule and pentane, iodine, and methylene chloride are non-polar molecules. Density also plays a role in the separation. So, that is why we must pour in the water second to separate the pentane and iodine from the methylene chloride.

3. Experiment 3—The Soda Bottle Crunch (Materials: empty soda bottle with the cap available, tub or sink of ice-cold water, hot tap water)

   For this whole-class experiment, fill the plastic soda bottle and fill it up with hot tap water. Let the hot water sit in the bottle for several seconds. Then, quickly pour out the water and put the cap onto the soda bottle. Put the bottle directly in the ice water. Wait and watch. The soda bottle should crumble right then and there.

   Explanation of what is happening: "Heating a gas will cause it to expand, and cooling a gas will reduce the pressure it exerts. Hot tap water in the bottle heats the sides of the bottle, which, in turn, heats the air inside. When a cap is tightened on the bottle after heating it with hot water, the air trapped inside is warm air. When the bottle is plunged into the cold water, the gas inside is cooled, exerting less pressure on the inside wall than the atmosphere is exerting on the outside of the wall. The atmosphere can then push on the wall, and the result is a crushed soda bottle" (12).

4. Experiment 4—Foam Cup Dissolving Experiment (Materials: 2 foam cups, 1 clear container of water, 1 clear container of acetone: can use fingernail polish remover with acetone)

   For this whole class experiment (which we did in my seminar), tell students that for each of the containers with liquid, to watch and tell what happens to the foam cup. Put the foam cup in the water and discuss how the cup simply floats. Put the other foam cup in the acetone and discuss the change. The foam cup will dissolve in the acetone. Have students discuss, observe, and record in their journals.

5. Experiment 5—Bobbing Raisins (Materials: 1 clear glass jar, clear carbonated drink, a handful of about 4-6 raisins)

   For this whole class experiment, pour the carbonated drink into the glass jar. Drop in the handful of raisins and watch what happens. The raisins will bob up and down within the carbonated drink.

Explanation of what is happening: "The bobbing up and down works because the bubbles of carbon dioxide gas in the drink are much less dense than the drink or the raisins.
Once the raisins start bobbing up and down, they will continue to rise and fall for about an hour.
-Raisins are denser than the carbonated drink, so they will sink.
-Gas bubbles attach to the wrinkles on the raisins.
-When the raisins are covered with the bubbles they become less dense than the drink, so they start to rise.
-The gas bubbles start bursting and then the raisins become denser than the drink, so they sink again" (13).

6. Experiment 6—Color Float (Materials: 2 clear glass jars, water, food coloring, a spoon, table salt)

For this whole class experiment, follow this procedure (14):

1. Add a couple of teaspoons of salt to one of your glasses and add several drops of your food coloring to the other glass.
2. Slowly pour in some warm tap water to both of the glasses. Stir the salt water until the salt dissolves completely and stir the food coloring into the other glass until the food coloring mixes.
3. Slowly pour some of the food coloring tap water into your salted tap water glass.
4. Watch to see what happens to the mixture.
5. & 6. Keep a watch to see how the colored water rises to the top of the salted water.

Explanation of what is happening: The colored tap water has move to the top of the salted tap water because salt water is heavier than tap water (15).

In the first lesson, the students will sort items into groups. These items are up to the teacher to find what is available in the classroom environment. Students will not be told how to sort them, but, they will receive a spread of solids and liquids to manipulate at their tables. These substances may include, but are not limited to: blocks, tiles, cubes, pencils, crayons, magnets, nails, foam balls, toys, syrup, dish liquid, hand sanitizer, juice, water, etc. Students will be allowed to sort as they see fit, but, we will then have a class discussion to allow table groups to share their sorting strategies and tactics. If no one

sorts by solids and liquids, I will question students about more ways to sort. Ask about whether they could sort by properties such as items that flow or do not flow, items that can change shape or not, or items that could have a straw easily pushed through it or not if the item could sink or float in water, if the item can be measured. If they have not come up with these ways, have students sort their items at their tables as you go through each property. Discuss with students that the ways that we are able to sort solids and liquids helps us determine their *properties*. The students will record the ways that they were able to sort as properties on a teacher-created chart (See Resource #1). After completing the chart, the students will discuss how matter can be classified as a solid, liquid, or a gas. We will use the periodic table at the following website to help with the explanation of solids, liquids, and gases on the periodic table: http://elements.wlonk.com/Elements_Pics+Words_11x8.5.pdf. This is a periodic table that uses pictures to explain which elements are solids, liquids, and gases. The students use the key to tell and the picture as well to show which state of matter an element is. They will then need to create a definition for matter in their groups and it will be discussed as a class to come up with a class definition.

In the second lesson, the students will review the content from the first session, such as properties of matter and the definition for matter. The teacher will share that matter is made up of chemicals that are found on a table called the Periodic Table. Show a periodic table of elements and allow students to tell what they notice about the organizer. We will use the website from the previous lesson and we will compare it to the periodic table of elements from http://www.webelements.com/. On this site, the uses of each item are described. The states of matter are described and there are real-life pictures and videos included of how that element is used and what happens when it reacts with other substances. In this lesson, I will describe what atoms are and tell students that they are the teeny, tiny parts of a substance. I will use the following website to depict the structure of the atoms and electrons: http://education.jlab.org/qa/atom_model.html. We will discuss the atomic number from the periodic table and compare that number with the number of electrons on the models presented from the website. Then, I will tell students that in order for molecules to be happy, they have to have 8 electrons on the outer shell and we will practice putting elements together to create happy molecules. I plan to introduce Bohr's model by showing the diagram on the previous website, http://education.jlab.org/qa/atom_model.html. The gist of the lesson will be about having the students understand that the electrons are the reason that chemical elements can mix together to create new substances. We will use the table in the Resources Section regarding the Bohr's model. I will have those cut out and will use the periodic table to model how to figure out which model goes with which element for carbon and neon. Then, I will take the models of NaCl (from Resource #2) to demonstrate how the elements want to be happy and these two elements can easily combine because the total of electrons in their outer shell will equal 8. After that, I will have the children try to come up with all the ways that they can create equations to equal 8. We will then take those equations to determine which elements on the periodic table would go well together

when trying to create “happy” molecules. If a child says that 6 plus 2 equals 8, then we will find elements with 6 electrons in their outer shell and elements with 2 electrons in their outer shells to go together. For example, Magnesium (Mg) and Oxygen (O) would match and go together because Mg has 2 electrons and O has 6 electrons. It creates Magnesium Oxide.

In the third through sixth lessons, the students will have the opportunity to conduct some experiments that will affect them positively in real life. They will have a chance to answer questions about physical and chemical changes and they will share their findings with others from this project-based, collaborative experience.

The third lesson will be making slime. We will use a recipe to create the slime, but, the students are going to be told that their community has been covered with pollution and there has been a discovery that a mixture of chemicals will create a substance that can be rubbed on the buildings and streets and other solid areas in order to collect the pollution and make the community more livable for the citizens. During this lesson, they are the detectives that are to create the substance that will help clean up the community. The students will be given the materials and they will have the chance to determine how much of each ingredient may need to be mixed together to create the slimy substance. After students have used trial and error to try to create the slime, I will give them the recipe and allow them to try using that if they did not find the recipe that their town should use. After this hands-on experience, we will have a Socratic seminar to discuss the following questions: “What is the process like when you are a scientist trying to come up with a way to solve a problem without any guidance? What did you and your partner do when the mixture did not turn out to be like slime? How did you try to come up with the correct solution?”

The slime recipe is as follows: “There are two components to slime. There is a borax and water solution and a glue, water, and food coloring solution. Prepare them separately.

- Mix 1 teaspoon borax in 1 cup of water. Stir until the borax is dissolved.
- In a separate container, mix 1/2 cup (4 oz) white glue with 1/2 cup water. Add food coloring, if desired.

After you have dissolved the borax and diluted the glue, you are ready to combine the two solutions. Stir one slime solution into the other. Your slime will begin to polymerize immediately. The slime will become hard to stir after you mix the borax and glue solutions. Try to mix it up as much as you can, then remove it from the bowl and finish mixing it by hand. It's okay if there is some colored water remaining in the bowl” (16) This is a chemical reaction because all of the beginning ingredients are no longer the same substance. A completely new substance has been created.

The fourth lesson will be making hydrogen bubbles. The students will put iron nails (or steel wool may be used) into vinegar and observe the bubbles that appear. They will record their observations and discuss. There will be a Socratic seminar session that will address why the students think that bubbles occurred within their experiment. According to http://www.exploratorium.edu/science_explorer/copper_caper.html, "**Why did bubbles come off the steel screw (or sample of steel wool)?** Each water molecule is made up of two hydrogen atoms and an oxygen atom. In an acid (like vinegar or lemon juice), lots of hydrogen ions (hydrogen atoms that are missing an electron) are floating around. In the chemical reactions at the surface of the screw, some of these hydrogen ions join and form hydrogen gas. The bubbles that you see coming off the screw are made of hydrogen gas." (17) After the Socratic seminar, make sure that students are shown (if it does not come up) about the equations for vinegar and water, so that they understand that hydrogen is in the equations and that's why the bubbles are coming out as a gas.

The fifth lesson will be creating an explosion with coke and Mentos candies. This lesson must occur outside in a very open space where students have plenty of room to move around. Each partner set of students will receive a poncho, a bottle of coke, and 2 Mentos candies. They will need to work together to be sure that one of the students sets up the bottle of coke away from other groups. The second partner will need to put on the poncho and get out the Mentos candy pieces. The first partner needs to stand back while the partner wearing the poncho puts the candies quickly into the coke bottle and then runs away. The reaction will happen quickly, so, both partners need to be looking at what happens. They will need to record their observations in their observation journals and begin talking about why they think that the explosion happened with the candies and the soda. The discussion will occur when the students get back to the classroom about why they believe the explosion occurred. Explanations and videos of this experiment can be found at: http://www.stevespanglerscience.com/experiment/original-mentos-diet-coke-geyser. Students should discuss the ingredients in soda and how the chemicals from soda will react with ingredients in Mentos candies.

The sixth lesson will be creating swirling milk and discussing the reaction that occurs. Give the students the appropriate materials and they will need to follow the following procedure:

1.Pour some milk into the pan. Allow the milk to come to room temperature.
2. Add a few drops of different colored food coloring into the pan of milk.
3. Add a few drops of liquid dish soap into the pan of milk.
4. Watch to see what happens.

The fat in the milk is broken down by the liquid soap. Protein molecules can be considered a reaction because the molecule does not go back to its original form. This causes the food coloring to swirl and make some really neat designs (18). Again, the

students will need to record their observation in their observation journals and then have a Socratic seminar about their findings. Another variation of the experiment can be found at: http://www.terrificscience.org/lessonpdfs/SwirlingMilk.pdf.

The seventh experiment is called the "Fighting Plaque" experiment. The students will follow the procedure from "Kids Science Experiments": (19)

1 .Before you brush your teeth, bite one of the disclosing tablets between your teeth.
2. Spread the liquid from the tablet with your tongue all around your mouth so that it covers and reaches your all your teeth and gums.
3. Do not swallow the tablet or liquid that it releases.
4. Rinse out your mouth once or twice with fresh water
5. The disclosing tablet will stain all the areas where decay can occur with a bright red color. (These are the areas where there is plaque build-up)
6. Brush your teeth with toothpaste until all the red stains have disappeared.

As the plaque experiment is a simulation, I will use the following PDF in order to show what happens when a tooth decays. Scroll down to page 17 for the information: http://www.rsc.org/images/AdditionalMaterial_tcm18-189094.pdf.

I will choose to do this experiment on a Friday so that students will have the weekend to brush away all the red stained areas. I will also be sure to let my parents know about the experiment so they are aware of the effects and the purpose of those effects.

Resources:

Resource #1

Name_____
Date_____

Solids and Liquids Chart

Ways I Sorted (list your groups)	Items in Each Group

An item is a solid if:

_____

_____

An item is a liquid if:

_____

_____

An item is a gas if:

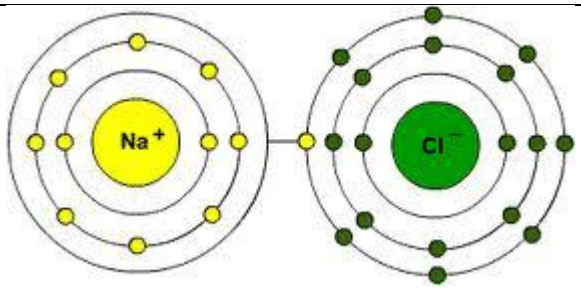
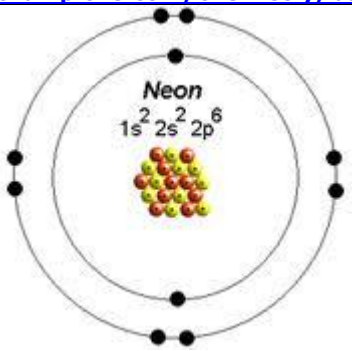
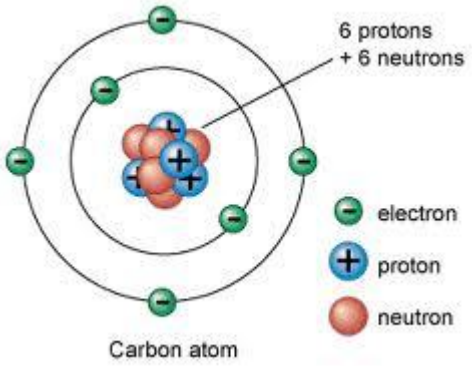
_____

_____

Class Definition of Matter:

_____

Resource #2

NaCl (salt)	 Image from: **www.school-for-champions.com/chemistry/bonding_types.htm**.
Neon	 Image from: http://www.green-planet-solar-energy.com/the-element-neon.html
Carbon	 Image from: http://www.universetoday.com/56637/atom-model/

Resource #3

Name_____

Date_____

Secret Code Questions

Directions: For many of the experiments we do throughout this unit, there will be a question that needs to be recorded at the end. The first letter of each answer (unless is says last letter) will need to be unscrambled at the end of the unit to tell another word we could use to describe someone who is a chemist.

1. In experiment 1, what did we create?
   _____

2. In lessons 1 and 2, we used the Periodic _____ of Elements to help us understand electrons.

3. What crumbled in experiment 3?
   _____

4. What is the last letter of the substance that made the foam cup dissolve in experiment 4?
   _____
   _____

5. What kind of bubble did you create in lesson 4?
   _____
   _____

6. In the 7th lesson, the color from the tablet on your teeth was left wherever there was plaque build-_____.

Letters: _____

Unscamble the letters to crack the secret code:
_____

Answer Key

1. **L**ava lamp
2. **T**able
3. **S**oda Bottle
4. Aceton**E**
5. **H**ydrogen
6. **U**p

Appendix for State Standards

The following standards are addressed within my unit:

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Investigate and observe how mixtures can be made by combining solids, liquids or gases and how they can be separated again.

Objective 3.06

Observe that a new material is made by combining two or more materials with properties different from the original material.

Notes

1. Karina Adbo and Keith S. Taber, "Learners' Mental Models of the Particle Nature of Matter: A Study of 16-Year-Old Swedish Science Students." *International Journal of Science Education* 31 (2009): 757-786
2. "Dictionary.com." accessed on November 13, 2011, http://dictionary.reference.com.
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Teacher Resources

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This article demonstrates results of a study completed about the effects of using models to teach chemistry in the high school environment.

Brears, L., B. MacIntyre, and G. O'Sullivan. "Preparing Teachers for the 21st Century Using PBL as an Integrating Strategy in Science and Technology Education." *Design and Technology Education* 16, no. 1 (2011): 36-46.

Cobb, Cathy, and Monty L. Fetterolf. *The joy of chemistry: the amazing science of familiar things*. Amherst, N.Y.: Prometheus Books, 2005.

This book breaks down lots of chemistry topics and begins each chapter with directions for an experiment that can be done at home. It is good to read for background information.

"Copper Caper," accessed on November 27, 2011, http://www.exploratorium.edu/science_explorer/copper_caper.html

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This site is for looking up exact definitions as I did for certain chemistry terms.

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This is a study that demonstrates that student achievement increases when students have experiences with hands-on science.

"Jefferson Lab Questions & Answers" accessed on November 3, 2011, http://education.jlab.org/qa/atom_model.html

This website discusses the structure of the atom and references Bohr's Model.

"Kids Science Experiments—Bobbing Raisins," Accessed on November 4, 2011, http://www.kids-science-experiments.com/bobbingraisins.html

This site explains the procedures for the experiment.

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This website is an explanation of the lava lamp experiment.

"National Paideia Center Philosophy," accessed on November 25, 2011, http://www.paideia.org/about-paideia/philosophy/

This website has lots of information about the philosophy behind and ways to incorporate Paideia seminars (similar to Socratic seminars).

"North Carolina Extended Essential Standards Science K-2," accessed on September 5, 2011, http://www.ncpublicschools.org/docs/acre/standards/extended/science/k-2.pdf

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This dissertation encourages teachers to use effective strategies to teach science that will promote engagement because of hands-on lessons.

"Step-by-Step Slime Instructions," Accessed on November 27, 2011, http://chemistry.about.com/od/chemistryactivities/ss/slimerecipe_4.htm

This website shows each step for the experiment.

"Swirling and Churning Milk," accessed on November 3, 2011, http://www.terrificscience.org/lessonpdfs/SwirlingMilk.pdf

This website is an explanation of the swirling milk experiment.

"YouTube Socratic Seminar Video," accessed on November 27, 2011, http://www.youtube.com/watch?v=QxZMGK6IdEs

This site shows a video of a teacher implementing the Socratic Seminar.

Student Resources

"Chemical Reactions," accessed on November 12, 2011, http://www.chem4kids.com/files/react_intro.html

This site explains the science behind chemical reactions.

"The Periodic Table of the Elements, In Pictures," accessed on November 12, 2011, http://elements.wlonk.com/Elements_Pics+Words_11x8.5.pdf

This site has a periodic table in pictures and words.

"Web Elements," accessed on November 12, 2011, http://www.webelements.com

This site has a periodic table with real-life photos and videos of elements and reactions.