It's All About Matter!

Grade Level: 4th Grade
Written by: Marcia Honer, Lincoln Academy Charter School, Arvada, Colorado
Length of Unit: Three weeks

I. ABSTRACT

This unit is intended to provide fourth graders with an overview of chemistry and to provide their teachers with lessons to cover all of the fourth grade chemistry requirements in the *Core Knowledge Sequence*. Through observation and hands-on activities the students will gain a foundation for their understanding of the exciting world of matter. The unit uses a variety of approaches to learning, including making models, doing experiments, and developing a science journal. This unit is designed to lay the foundation for, and be continued in the fifth grade unit, "It's Still All About Matter" written by Linda Siebert.

II. OVERVIEW

A. Concept Objectives
   1. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process (Jefferson County Public Schools Science Content Standard #2).
   2. Know and understand common properties, forms, interactions, and transformations of matter and energy (Jefferson County Public Schools Science Content Standard #6).

B. Content from the *Core Knowledge Sequence* (pages 104-105)
   1. Atoms
      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
         i. Positive charge (+): proton
         ii. Negative charge (-): electron
         iii. Neutral (neither positive nor negative): neutron
         iv. "Unlike charges attract, like charges repel" (relate to magnetic attraction and repulsion)
   2. Properties of matter
      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. Elements
      a. Elements are the basic kinds of matter, of which there are a little more than one hundred.

b. There are many kinds of atoms, but an element has only one kind of atom.
c. Familiar elements, such as gold, copper, aluminum, oxygen, iron.
d. Most things are made up of a combination of elements.

4. Solutions
   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.
   b. Concentration and saturation (as demonstrated through simple experiments with crystallization)

C. Skill Objectives

1. Students will understand that patterns of organization provide useful ways of interpreting the world (Jefferson County Public Schools Science Content Standard 1.1).
2. Students will understand that most things are in the process of change and that there are patterns to these changes (Jefferson County Public Schools Science Content Standard 1.2).
3. The student will seek answers by making careful observations and trying things out (Jefferson County Public Schools Science Content Standard 2.1B).
4. Students will follow written directions (Jefferson County Public Schools Science Content Standard 2.1D).
5. Students will describe and compare things using characteristics such as shape, color, size, texture, weight, numbers, and motion (Jefferson County Public Schools Science Content Standard 2.1E).
6. Students will use charts, graphs, and tables to organize and explain data (Jefferson County Public Schools Science Content Standard 2.2B).
7. Students will use tools to observe, measure, and make things (Jefferson County Public Schools Science Content Standard 3.1B).
8. Students will begin to use computers (Jefferson County Public Schools Science Content Standard 3.1C).
9. Students will describe and compare objects based on common physical properties such as length, weight, volume, and temperature of objects (Jefferson County Public Schools Science Content Standard 6.1B).
10. The student will measure physical characteristics such as the length, weight, volume, and temperature of objects (Jefferson County Public Schools Science Content Standard 6.1B).
11. Students will recognize that all objects are made of one or more materials and identify the sources of some of the materials (Jefferson County Public Schools Science Content Standard 6.1C).
12. Students will observe and describe the parts of a system (Jefferson County Public Schools Science Content Standard 6.3A).
13. Students will predict and measure what changes and what remains unchanged when an object is acted upon by an external influence (Jefferson County Public Schools Science Content Standard 6.3C).

III. BACKGROUND KNOWLEDGE

A. For Teachers

1. Frank, D. V., Little, J. G., & Miller S. *Science Explorer: Chemical Building Blocks*. New Jersey: Prentice-Hall, Inc., 2002. ISBN 0-13-054091-9

2. Frank, D. V., Little, J. G., & Miller S. *Science Explorer: Chemical Interactions*. New Jersey: Prentice-Hall, Inc., 2002. ISBN 0-13-054094-3
3. Wiley, D. & Royce, C., *Physical Science*, Michigan, Instructional Fair, ISBN 1-56822-479-6

B. For Students
1. Hirsch. E. D., *What Your 1st Grader Needs To Know,* New York, Dell Publishing, ISBN 0385-48119-5

IV. RESOURCES

See Bibliography

V. LESSONS

Lesson One: What is Matter? (Two 45-minute lessons)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.
   b. Know and understand common properties, forms, interactions, and transformations of matter and energy.
2. Lesson Content
   a. Properties of matter
      iii. Mass: the amount of matter in an object, similar to weight
      iv. Volume: the amount of space a thing fills
      v. Density: how much matter is packed into the space an object fills
      vi. Vacuum: the absence of matter
3. Skill Objective(s)
   a. The student will seek answers by making careful observations and trying things out.
   b. The student will measure physical characteristics such as the length, weight, volume, and temperature of objects.
   c. Students will describe and compare things using characteristics such as shape, color, size, texture, weight, numbers, and motion.
   d. Students will use tools to observe, measure, and make things.
   e. Students will describe and compare objects based on common physical properties such as length, weight, volume, and temperature of objects.

B. *Materials*
1. Sheet of butcher paper
2. Graduated cylinders, beakers, or clear plastic glasses marked in milliliters for each group of children
3. Various sizes of blocks or small boxes
4. Various sizes of irregular shaped objects that are small enough to fit into the graduated cylinder and heavy enough to sink (ex: marbles, rocks, hard candy, balls of modeling clay, chunks of carrots, etc.)
5. Metric ruler for each group of children
6. Water
7. Scale
8. One bag of microwave popcorn

9. Microwave
10. One jar for each group of children
11. Vegetable oil
12. Four to six various small objects for each group of children (ex: coins, paper clips, push pins, clay balls, pencil erasers, foam pieces, small plastic toys, birthday candles)
13. Science journal with brads and paper, for each child (this folder is for notes and models accumulated during this unit; it may be saved and used for the Chemistry unit in 5th grade)

C. *Key Vocabulary*

1. Matter: Anything that takes up space (has volume) and has mass.
2. Mass: How much matter an object contains. Most people will think that this is the same thing as weight. On earth this is fairly true, but since weight is really the gravitational pull on an object it can change depending on where it is weighed (you weigh a lot less on the moon then you do on earth because there is less gravity, but your mass is the same in either place because the amount of matter you contain does not change).
3. Volume: The amount of space an object occupies. In rectangular objects it is measured by Volume = Length x Width x Height.
4. Density: Density is the measure of matter is contained in a given volume. To calculate the density of an object you can divide its mass by its volume (Density = Mass/Volume.
5. Vacuum: The absence of matter.

D. *Procedures/Activities*

1. Explain to students that this unit of science is the study of everything in our physical world. It is everything that takes up space and has mass. Explain that mass is a measure of the amount of matter that an object contains. Use the butcher paper and have the class brainstorm what they think is matter and what isn't. As you add words to the chart, discuss why each example is matter or not. Your chart might look something like this:

Matter	Not Matter
Cars	Ideas
Oranges	Running
Rocks	Shadow
Sun	Light (energy)
Etc…	Etc…

   Tell the students that when there is no matter present, we call it a vacuum.
2. Since all matter takes up space, it has a definite volume. The students will determine volume in two different ways. First, have them measure the height, width and length of the rectangular objects using centimeters. Show them that if they multiply these dimensions (L x W x H = Volume) they will get the volume of the rectangular prism in cm^3.
3. The students can measure the volume of irregular objects using displacement of water. Fill the graduated cylinders half full with water. Have the students record how many milliliters of water are in the cylinder. Drop various irregular objects into the cylinder and have students record the volume of water with each object. Subtract the original volume from the new volume to determine the volume of the object in milliliters. Since 1 milliliter = 1 cm^3, the students can compare the volumes of rectangular and irregular objects which have been determined by the two different methods.

4. Next, the students will observe another characteristic of matter, density. This is done as a demonstration to the children. Weigh a bag of microwave popcorn and record the weight. Pop the corn and then weigh it for the children again. Discuss how the weight has stayed the same even though the volume has increased. Since density is the amount of matter contained in a given volume, as the volume of the popcorn increases the density of it decreases (the matter of the popcorn seed is packed more closely together than the popcorn kernel, so the kernel is more dense).
5. The students will now make their own density jar to observe the differences in density of various common objects. Give each group of students a jar filled 1/3 with water and 1/3 with vegetable oil. Have each group place 4-6 small items in the jar and cap tightly. Shake the jar then let the objects settle. Anything that floats on top of the water has a lower density than the water (1 g/cm^3). Anything that sinks to the bottom is denser than the water (adapted from phschool.com)

E. *Assessment/Evaluation*
1. Assess students for understanding while they are working on these experiments. Have each child enter into their Science folder the meaning of terms and concepts that have been introduced. These should include, but not be limited to: matter, mass, volume, density and vacuum.

Lesson Two: The World of Atoms (one 45 minute lesson)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.
   b. Know and understand common properties, forms, interactions, and transformations of matter and energy.
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
      i. Positive charge (+): proton
      ii. Negative charge (-): electron
      iii. Neutral (neither positive nor negative): neutron
      iv. "Unlike charges attract, like charges repel" (relate to magnetic attraction and repulsion)
3. Skill Objective(s)
   a. Students will understand that patterns of organization provide useful ways of interpreting the world.
   b. Students will observe and describe the parts of a system.

B. *Materials*
1. Overhead transparency of Appendix B
2. Fifteen 3" circles cut from red paper, each with a "+" symbol on one side

3. Fifteen 3” circles cut from blue paper that are blank on both sides
4. Fifteen 2” green circles, each with a “-“ symbol on one side - place a small piece of magnetic strip (from craft stores) on the back of each circle if you have a magnetic white board or pieces of tape if you don’t have a magnetic board
5. Student science journal

C. *Key Vocabulary*

1. Atom: The smallest particle of an element.
2. Proton: A subatomic particle in the nucleus of an atom that has a positive charge.
3. Neutron: A subatomic particle in the nucleus of an atom that does not have an electrical charge.
4. Electron: A tiny, negatively charged, subatomic particle that moves around the nucleus of an atom.
5. Nucleus: The central region of an atom that contains protons and usually neutrons.
6. Shell: A region of space that is around the nucleus, is a band of energy and contains electrons.
7. Electron Cloud Model: The current model of atomic structure where electrons orbit the nucleus in energy levels called shells (these shells are three-dimensional regions of space, not lines as shown in many drawings of atomic structure which are based on the Bohr model).

D. *Procedures/Activities*

1. Remind the students that now that they know what matter is, they now need to investigate what matter is really like. Tell them that all matter is made of things called atoms. The word atom comes from the ancient Greek and means “uncuttable.” In other words, it is the smallest unit that matter can be cut into and still be matter (anything smaller is subatomic). Tell them that all atoms are so small that the strongest microscope can’t see them and they are made up of only three parts. Since you can’t see individual atoms you will have to make a model of them that represents what scientists think atoms look like. The first part is the proton, which will be symbolized by the red circles. Explain that these are particles that have a positive charge. The second, is the neutron, which is a particle that does not have a charge (so we call it neutral), they are represented by the blue circles. The last is the electron that is a very small particle that has a negative charge and will be represented by the green circles.
2. Project the transparency of Appendix B on the board or wall making it as big as you can.
3. Explain to the students that scientists believe that all atoms behave in the same way and are arranged in the same general pattern. Scientists call this arrangement the “Electron Cloud Model” of atomic structure. In the center of the atom is a nucleus where the protons and neutrons are concentrated. These two types of particles are evenly distributed throughout the center nucleus area. Show this by placing some of the red and blue circles in the nucleus area of the projected model (use the same amount of each).
4. The last type of particle is the electron. Tell the students that the green circles will represent these particles. Explain that the electrons are around the nucleus in what are called shells. According to the “Electron Cloud Model” the electrons travel in a region of space that is around the nucleus. Because it is hard to represent things on paper in a three dimensional manner you will place the electrons in the bands of the electron shells. Make sure that when you place electrons on a shell that you spread them apart because they repel each other (like charges repel). Tell the students that while this is not a totally accurate model of

an atom because it is not three dimensional, it gives us an idea of what they look like. It is also not totally accurate because in a real atom the nucleus is very, very tiny, and the electron cloud (the shells) can be as much as 100,00 times larger. Even though these electrons can be so far away from the nucleus they normally do not fly away because their negative charges are attracted to the positive charges of the protons in the nucleus (unlike charges attract).

E. *Assessment/Evaluation*

1. Have the students draw and label a model of an atom in their science notebook. Make sure that they include the neutron, proton, electron, nucleus, and shell. Also, label the positive and negative charges. While they are drawing the teacher should observe each student and check for understanding.

Lesson Three: The Periodic Table (one 45 minute lesson)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Know and understand common properties, forms, interactions, and transformations of matter and energy.
2. Lesson Content
   a. Elements are the basic kinds of matter, of which there are a little more than one hundred.
3. Skill Objective(s)
   a. Students will understand that patterns of organization provide useful ways of interpreting the world.
   b. Students will use charts, graphs, and tables to organize and explain data.

B. *Materials*

1. Copy of the Periodic Table of Elements for each student (these are available in many books or on the Internet)

C. *Key Vocabulary*

1. Element: A substance that is made of only one kind of atom.
2. Periodic Table: The chart that has been developed to organize the elements.

D. *Procedures/Activities*

1. Explain to students that atoms of the same substance frequently occur in groups that we call elements. These elements must be made up of only one substance.
2. Tell students that it helps to understand things if we can organize them in some way. The way that scientists have developed for elements is the Periodic Table. Give them each a copy of the Periodic Table. Explain that it is a chart that has organized the elements in several ways. Each row of elements is called a "period" (that is why it is a periodic table). Those elements that are in the same period (row) have something in common. They each have the same number of shells, so those in the first row have one shell, the second row has two shells, the third row has three shells, etc. They are also organized in columns that are called groups. Those elements that are in the same group (column) have the same number of electrons in their outer shell. The elements in the first column have one electron in the outer shell; the second has two electrons, etc. The elements in the section in the middle of the periodic table are called the transition elements. They are not in the main groups because they behave a little differently. They are the all metals and are usually hard and shiny. They are also usually good conductors of electricity. Any element over number 92 (Uranium) has been created in a laboratory by scientists.
3. Have the students look at one specific block in the periodic table. This block gives specific information for one atom of an element. In the center is the letter

or letters, which are the symbol for the element. Most charts also give the elements name under the symbol. In the upper left corner is the Atomic Number for the element. This number is the number of electrons and protons in one atom of the element in its neutral state. As an example, Oxygen has an atomic number of 8 and has 8 electrons and 8 protons. Now have them look at the lower right corner of the block. This is the atomic mass of an atom of the element.

4. Give the students the opportunity to find different elements and their characteristics on the periodic table. Use questions like the following:
   a. What element has the symbol _____?
   b. What is the symbol for _____?
   c. What is the atomic number for _____?
   d. What is the atomic mass for _____?

   Repeat this practice as many times as necessary to assure student understanding.

E. *Assessment/Evaluation*

1. Give the students the Periodic Table Crossword (Appendix A). Evaluate completed paper for accuracy and understanding.

Lesson Four: Build those Atoms! (Two 45-minute lessons)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.
   b. Know and understand common properties, forms, interactions, and transformations of matter and energy.
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
      i. Positive charge (+): proton
      ii. Negative charge (-): electron
      iii. Neutral (neither positive nor negative): neutron
      iv. "Unlike charges attract, like charges repel" (relate to magnetic attraction and repulsion)
   e. Familiar elements, such as gold, copper, aluminum, oxygen, iron.
3. Skill Objective(s)
   a. The student will seek answers by making careful observations and trying things out.
   b. Students will observe and describe the parts of a system.

B. *Materials*

1. One copy each of Appendices C, D, and E for each student
2. One transparency of Appendices B, C, D, E, and F
3. Overhead projector

4. Color coding dots from the office supply store in three colors; for each student you need 50 half-inch in color one, 57 half-inch in color two, and 50 one-fourth inch in color three
5. Three colors of overhead markers to match the colored dot for the students

C. *Key Vocabulary*

1. Electron Cloud Model: The current model of atomic structure where electrons orbit the nucleus in energy levels called shells (these shells are three-dimensional regions of space, not lines as shown in many drawings of atomic structure).

D. *Procedures/Activities*

1. Review atomic structure from Lesson Two.
2. Using the transparency of Appendix D and the three colored markers you will demonstrate to the students the atomic structure of The Iron atom. Draw 26 red dots in the nucleus of the atom to represent the protons. Add 30 blue dots in the nucleus to represent the neutrons. Make sure that you scatter both colors of dots throughout the nucleus. Draw two green dots in Shell One, to represent the electrons. Make sure these dots are opposite each other within the shell (like charges repel). Add 8 electron dots to Shell Two, 14 electron dots to Shell Three, and 2 electron dots to Shell Four. Again, make sure that the electrons are scattered throughout the shells. Discuss with the students that this is a model of an Iron atom according to the Electron Cloud Model.
3. Repeat this procedure for a Gold atom using transparency of Appendix F. Use 79 dots for protons, 118 for neutrons, and 79 for electrons. Place 2 electrons in Shell One, 8 in Shell Two, 18 in Shell Three, 32 in Shell Four, 18 in Shell Five, and 1 in Shell Six.
4. The students are now going to make their own models of Oxygen, Aluminum, and Copper. Give each student their colored dots and a copy of Appendix C. The Oxygen atom has 8 neutrons, 8 protons, and 8 electrons (2 in Shell One and 6 in Shell Two). Have the students make their atom using the colored dot. Use the transparency of Appendix C and draw the Oxygen atom. Have the students self-check their model for accuracy. Repeat this process for the Aluminum atom using student copies of Appendix F. Aluminum has 13 protons, 14 neutrons and 13 electrons (2 in Shell One, 8 in Shell Two, and 3 in Shell Three). Use the transparency of Appendix F to draw the Aluminum atom and have the students self-check.

E. *Assessment/Evaluation*

1. To evaluate the students' understanding of atomic structure based on the Electron Cloud Model, repeat the above procedure using the Copper atom. Give each student a copy of Appendix D. Tell them that Copper has 29 protons, 35 neutrons and 29 electrons (2 in Shell One, 8 in Shell Two, 18 in Shell Three and 1 in Shell Four). Have each student make his or her model of the Copper atom and assess for understanding based on the accuracy of the model.

Lesson Five: It's a Matter of State (one 45 minute lessons)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.

b. Know and understand common properties, forms, interactions, and transformations of matter and energy.

2. Lesson Content
   a. Properties of matter
3. Skill Objective(s)
   a. Students will understand that most things are in the process of change and that there are patterns to these changes.
   b. The student will seek answers by making careful observations and trying things out.
   c. Students will describe and compare things using characteristics such as shape, color, size, texture, weight, numbers, and motion.
   d. Students will describe and compare objects based on common physical properties such as length, weight, volume, and temperature of objects.

B. *Materials*
1. Large Ziploc bag (heavy freezer type)
2. Ice cubes (these can be made with a little bit of flavoring oil like lemon or cinnamon oil so that when it evaporates the students can smell the gas)
3. Microwave oven
4. Science journal

C. *Key Vocabulary*
1. State of matter: Also known as a phase of matter. There are four states: solid, liquid, gas, and plasma. These phases describe the physical state of matter where the form of the matter changes but the identity of the matter does not change. When a physical force like temperature changes are applied, the state of matter can change. Chemical forces do not change the state of the matter but change the chemical structure of the matter.
2. Solid: A state of matter in which the matter has a definite volume and a definite shape. The atoms in a solid do not move around very much. The electrons still spin around the nuclei bet the atom itself can move very little.
3. Liquid: A state of matter in which the matter has a definite volume but does not have a definite shape. The atoms in a liquid are able to move and are further apart than in a solid. A liquid also has more energy than a solid. This additional energy is usually in the form of heat.
4. Gas: A state of matter in which the matter does not have a definite volume or shape. Gas is a random group of atoms that have a lot of energy and the molecules are spread far apart and are moving quickly.
5. Plasma: A state of matter in which some of the electrons of the atoms has been stripped off. You end up with some positively and some negatively charge atoms as well as free electrons. When these atoms are in equal concentrations you have a glowing mass of plasma. Plasma is very much like gas but it takes a tremendous amount of energy to knock off the electrons. Plasma does not regularly occur on earth except in the form of ball lightening or the northern lights. Man-made plasma is common in the form of neon and fluorescent lights. Plasma is also what you see when you look at a star.

D. *Procedures/Activities*
1. Describe to the students the four states of matter. Tell them that everything (all matter) occurs in one or several states of matter. Explain that in order for matter to go from one state of matter to another that you must either add or take away energy. Since it is easier in the classroom to add energy than take it away, you will do a demonstration where you add a common form of energy to water.

2. Ask students what they would call the solid state of matter for water. Show them the ice cubes that you place in the Ziploc bag. Show them how it has a definite shape and volume. Make sure that when you seal the bag you push most of the air out. Ask them what will happen when you add energy to the water.
3. Place the bag of ice in the microwave oven and microwave for several minutes (enough time to melt the ice, depends on the wattage of your microwave). Ask what the liquid state of water is called. Show them that is has a definite volume but not a definite shape.
4. Ask the students what will happen when you add more energy to the water. Place the bag back in the microwave oven and heat enough to vaporize the water. Show the students how the gas does not have a definite shape or volume. Also point out that the water molecules have so much energy and are moving around so fast that they take up more room. Most gases we cannot see so open the bag and if you have added the flavoring oil to the ice cubes the students should be able to smell the gas from the bag.

E. *Assessment/Evaluation*

1. Help the students describe in their own words what the states of matter are and what the characteristics of each state are. Have them write this in their science journal. Also have them include their observations of what happened during the ice cube demonstration.

Lesson Six: What is the Solution? (One 45-minute lesson)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.
   b. Know and understand common properties, forms, interactions, and transformations of matter and energy.
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. The student will seek answers by making careful observations and trying things out.
   b. Students will follow written directions.
   c. Students will describe and compare things using characteristics such as shape, color, size, texture, weight, numbers, and motion.
   d. Students will recognize that all objects are made of one or more materials and identify the sources of some of the materials.
   e. Students will predict and measure what changes and what remains unchanged when an object is acted upon by an external influence.

B. *Materials*

1. Several black, water-soluble markers from different manufacturers
2. Clear beakers or tall clear plastic glasses (the same number of containers as you have markers); you will need one set of these for each group of children
3. Water

4. Paper clips (the same number as you have containers)
5. 1" strips of paper towels or coffee filters (the same number as you have containers); these should be 1 ½ times longer than the container is high
6. Science Journal
7. Colored pencils, crayons or markers for illustrating lab results

C. *Key Vocabulary*

1. Compound: A substance that is made up of two or more elements that have been chemically combined. The properties of a compound are always different then those of the elements that make up the compound.
2. Mixture: A combination of two or more substances that have been physically combined but not chemically combined. The substances that make up a mixture do not change their characteristics when they combine in the mixture. The individual parts of a mixture can be separated by various means like evaporation, condensation, distillation, gravity, and capillary action.
3. Solution: A special kind of mixture where the substances are so well mixed that they appear to be a single substance. It is made up of the solvent, which is the dissolving substance and the solute, which is the less abundant substance.
4. Chromatography: The separation of colors based on the principle that capillary action will separate materials of different densities.

D. *Procedures/Activities*

1. Explain to the children that when molecules of different substances are mixed together we create either a compound or a mixture. When you create a mixture the substances have just been physically combined, but their chemical properties do not change. This is true even if the mixture looks like it is only one substance. Since the substances have not been changed we can separate them back into their original form. It is different with a compound. When a compound is created the chemical properties of the substances change and the result is a different substance with different properties and the process is not reversible. For example if I get a piece of paper wet I have a mixture of water and paper. It undergoes a physical change that can be reversed if the water is allowed to evaporate. But, if I burn a piece of paper it undergoes a chemical change, which cannot be reversed, so the compound ash is created.
2. Explain that a solution is a special type of mixture where the materials are so well mixed that they appear to be one substance.
3. To experiment with this concept the class will take black markers and determine if they are solutions or if they are compounds. They will also determine if the black markers that all appear to be black are really the same, or if they are made up of different substances.
4. Explain the experiment to the students and have them write a hypothesis in their science journal. Put the materials and procedures on the board and have them copy these into their journal.
5. Have the students make a pea-sized dot of marker about 1 cm from the bottom of the paper towel strips. Use a different marker for each strip.
6. Place water into each container that is about 1 cm deep.
7. Carefully put the end of the paper towel with the dot into the water. Only let the very end touch the water. Be very careful not to let the ink spot directly touch the water. Paper clip the paper towel in place by clipping over the side of the container. Repeat this with each of the different strips.
8. Watch the strips as the water soaks into the paper. As the water rises up the toweling the colors will separate into the individual colors that the marker manufacturer has mixed to make black.

9. Have the students describe their results in their journal and color pictures showing how the colors separated for the different markers.
10. Have the students write a conclusion for the experiment in their journal. Tell them to explain if the markers are a compound or a mixture and what they think are the differences between the markers.

E. *Assessment/Evaluation*
1. Collect the student's science journals and evaluate if they have followed correct scientific procedures in their write up of the experiment.

Lesson Seven: We Are to the Point of Saturation! (One 45-minute lesson)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.
   b. Know and understand common properties, forms, interactions, and transformations of matter and energy.
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.
   b. Concentration and saturation
3. Skill Objective(s)
   a. The student will seek answers by making careful observations and trying things out.
   b. Students will follow written directions.
   c. Students will use charts, graphs, and tables to organize and explain data.

B. *Materials*
1. Two 100 ml graduated cylinders
2. 50 ml distilled water
3. 50 ml rubbing alcohol
4. Two beakers, graduated cylinders or clear plastic glasses per student group
5. Two spoons per student group (the little taste-testing spoons work great)
6. Sugar
7. Salt
8. Hot and cold water
9. Science journal

C. *Key Vocabulary*
1. Compound: A substance that is made up of two or more elements that have been chemically combined. The properties of a compound are always different then those of the elements that make up the compound.
2. Solution: a special kind of mixture where the substances are so well mixed that they appear to be a single substance. It is made up of the solvent, which is the dissolving substance and the solute, which is the less abundant substance.
3. Mixture: A combination of two or more substances that have been physically combined but not chemically combined. The substances that make up a mixture do not change their characteristics when they combine in the mixture.
4. Saturation: The point at which the solvent cannot dissolve any more solute.

D. *Procedures/Activities*

1. In Lesson Six the students learned what a solution is. Describe to them that when substances are combined in a solution the atoms of the solute will fill up the spaces between the atoms of the solvent. The amount of the solute that the solvent can hold is determined by how much space there is between the atoms and on how big the atoms of the solute are.
2. Place the 50 ml of water in one cylinder and the 50 ml of alcohol in the other. Have the students observe the volume in each cylinder. Make sure that you measure carefully. Ask the students to predict what the volume of the liquid you will have if you were to combine the two liquids into one cylinder. Pour the alcohol into the water and observe the volume of the combined solution. The combined solution has less volume than the individual substances because the molecules of one substance are fitting inside the molecules of the other.
3. Explain to the students that they are going to do an experiment to see how much of two different solutes water will hold until the spaces are all filled up and it can't hold anymore (it is saturated). Explain the experiment to them and have them write a hypothesis, material, and procedures in their science journal.
4. Give each student group two containers with cold water in them. Do not place too much water in them or it will take a lot of sugar and salt to saturate the water (50 ml or less). Make sure that you have the same amount of water in each container.
5. Give the students the spoons, sugar and salt. Show them how to measure a level spoonful of the sugar and salt. Have them add a level spoonful of sugar to the cold water and stir. Observe to see if all of the sugar has dissolved. If it has, add another level spoonful and stir. Observe again and continuing adding one spoonful at a time until the sugar stops dissolving. Make sure that you record how much sugar has been added to the container.
6. Repeat this procedure with the other container of cold water and the salt. Record the results.
7. Dump out the contents of the two containers and rinse them out completely. Now give the students the same amount of hot water as they used for the cold-water trials. Repeat the above procedure with sugar and salt in the hot water.
8. Have the students make a chart of their results in their science journal and describe what they observed during the experiment.
9. Have the students write a conclusion in their science journal about the experiment. Make sure that they answer the question "What two factors determined the point of saturation for the water in this experiment?"

E. *Assessment/Evaluation*

1. Collect the student's science journals and evaluate if they have followed correct scientific procedures in their write up of the experiment. Make sure that they have answered what factors determine the saturation point of a liquid.

Lesson Eight: Concentration and Crystallization (one 45 minute lesson plus 3-4 days of observation)

A. *Daily Objectives*

1. Concept Objective(s)
   a. Understand that science is a framework for understanding the natural world based on experimentation and logical analysis. Understand the processes of scientific investigation and be able to design, conduct, communicate, and evaluate such investigations. Use the understanding of science in a decision-making process.

b. Know and understand common properties, forms, interactions, and transformations of matter and energy.

2. Lesson Content
   a. Concentration and saturation (as demonstrated through simple experiments with crystallization)
3. Skill Objective(s)
   a. Students will understand that most things are in the process of change and that there are patterns to these changes.
   b. The student will seek answers by making careful observations and trying things out.
   c. Students will describe and compare things using characteristics such as shape, color, size, texture, weight, numbers, and motion.

B. *Materials*
1. Water
2. Charcoal briquettes-one or two per child
3. Graduated cylinder or other mixing container
4. Ammonia-1/2 cup per child
5. Laundry bluing (from the grocery store)-one tablespoon per child
6. Food coloring-several colors to make it pretty
7. Salt
8. Pie plate or similar container
9. Science journal

C. *Key Vocabulary*
1. Evaporation: The process that takes place when a liquid vaporizes and becomes a gas.
2. Crystal: The repeated arrangement of atoms into a regular form. A crystal takes its form from the particular combination of its chemical elements. As a solution evaporates and becomes a solid the atoms arrange themselves in repeating units. The crystals grow as the units repeat themselves enough time to become visible.

D. *Procedures/Activities*
1. Now that the students know about the states of matter, solutions, and saturation, explain that they will now have the opportunity to see what happens when a saturated solution evaporates (the liquid becomes a gas).
2. Place charcoal briquettes in the pie plate.
3. Mix a solution of ½ cup ammonia and 1 tablespoon laundry bluing. Caution students not to inhale the fumes from the ammonia. Stir in one spoonful of salt at a time until no more will dissolve and the solution is saturated.
4. Pour the solution over the charcoal. Have students add a few drops of food color over the tops of the briquettes. This can be done straight from the food color bottle but is neater if you have them use an eyedropper or pipette.
5. Place the pie plate in a place where it will not be disturbed for several days. Have students observe their charcoal twice a day for 3-4 days or until the water is totally evaporated.
6. Students should keep daily observations of the growth of their "Evaporation Garden" in their science journal.

E. *Assessment/Evaluation*
1. Have the students answer the following questions in their Science Journal.
   a. How long did it take for the crystals to grow?
   b. Where did they grow?
   c. What do they look like?
   d. Did the colors have any effect of the way that the crystals grew?

VI. CULMINATING ACTIVITY

A. To culminate this activity the students will research an element and make a model of it. The teacher should determine the amount of detail that they do in their research and what resources are available. Recommended information could include:

1. Uses of the element
2. Who the element was discovered by
3. How common is the element

The student should make a model of the element. This could be a paper model like they did in this unit, or it could be a three-dimensional model. If they choose to make it three-dimensional they can make it out of things like mini marshmallows and toothpicks, styrofoam balls and cardboard rings, or anything else that they can come up with. The research for this project can be done from library books or on the Internet. Several sites that might be useful are www.kapili.com, www.chemsoc.org, www.nsta.org, and www.chem4kids.com

VII. HANDOUTS/WORKSHEETS

A. Appendix A: Periodic Table Crossword Puzzle
B. Appendix B: Atom Model with One Electron Shell
C. Appendix C: Atom Model with Two Electron Shells
D. Appendix D: Atom Model with Three Electron Shells
E. Appendix E: Atom Model with Four Electron Shells
F. Appendix F: Atom Model with Six Electron Shells

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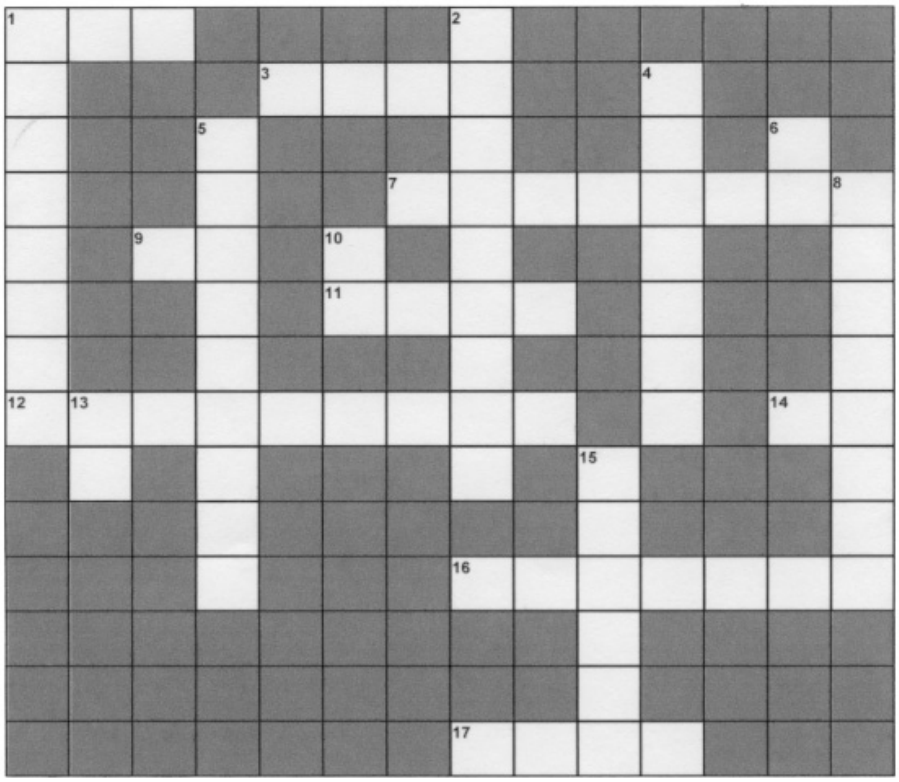
Appendix A-It's All About Matter

Periodic Table

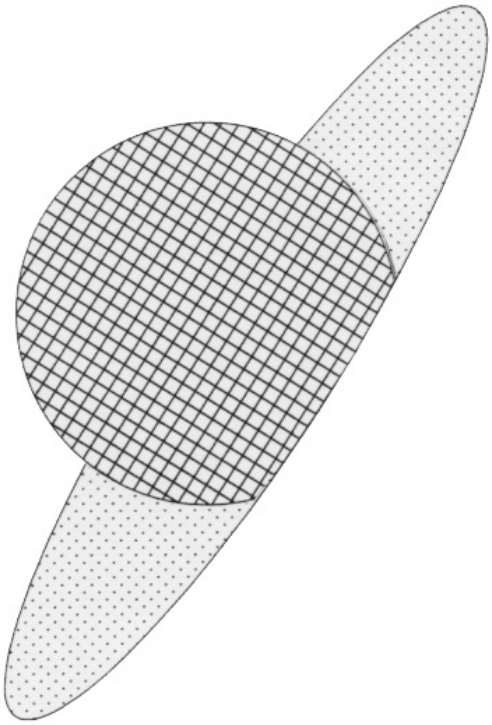


Across	Down
1. Atomic no. of Neon	1. My symbol is Ti
3. Atomic no. of Boron	2. My symbol is BE
7. Atomic mass of 1	4. Atomic number is 45
9. Symbol for Copper	5. Atomic mass of 242
11. Atomic number is 47	6. Symbol for Iron
12. Atomic number is 12	8. My symbol is N
14. Symbol for Cobalt	10. Symbol for Mercury
16. My symbol is Kr	13. Symbol for Aluminum
17. My symbol is Zn	15. My symbol is O

Appendix B-It's All About Matter

Atom Model with One Electron Shell

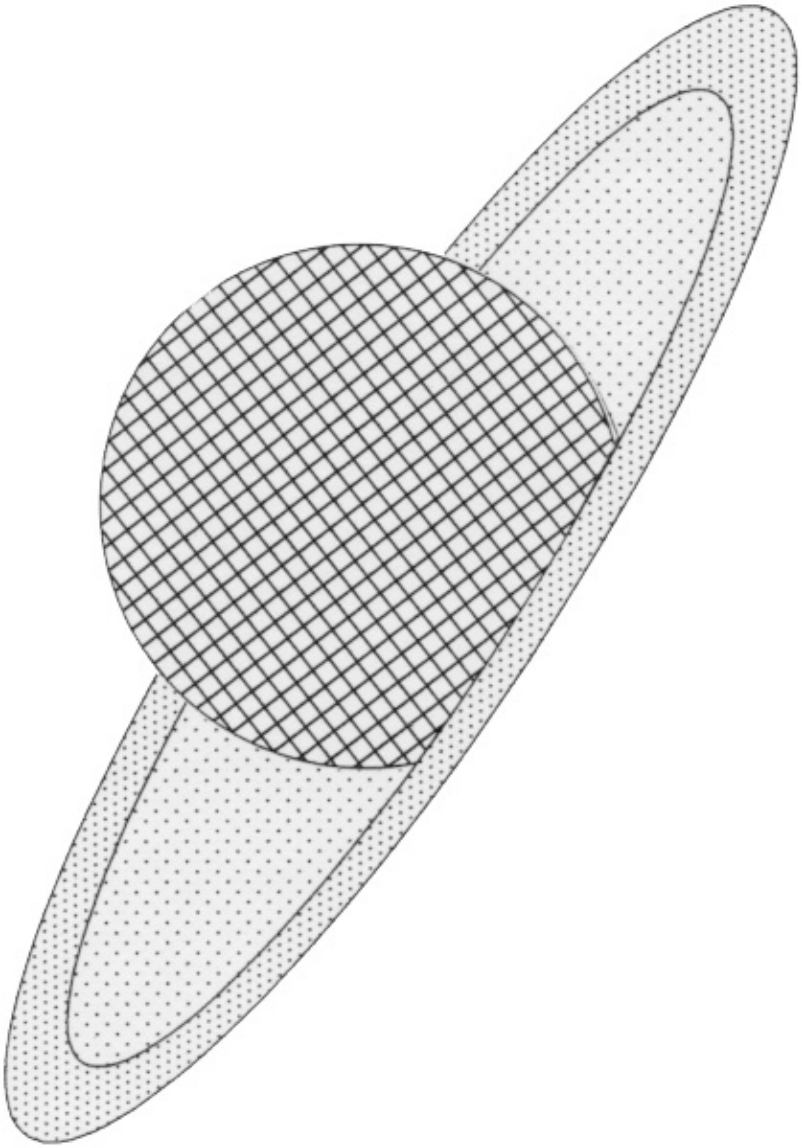
Student Name: _____
Name of element: _____
Symbol: _____
Atomic Number: _____
Atomic Mass: _____
Number of neutrons: _____
Number of electrons: _____
Number of protons: _____



Appendix C-It's All About Matter

Atom Model with Two Electron Shells

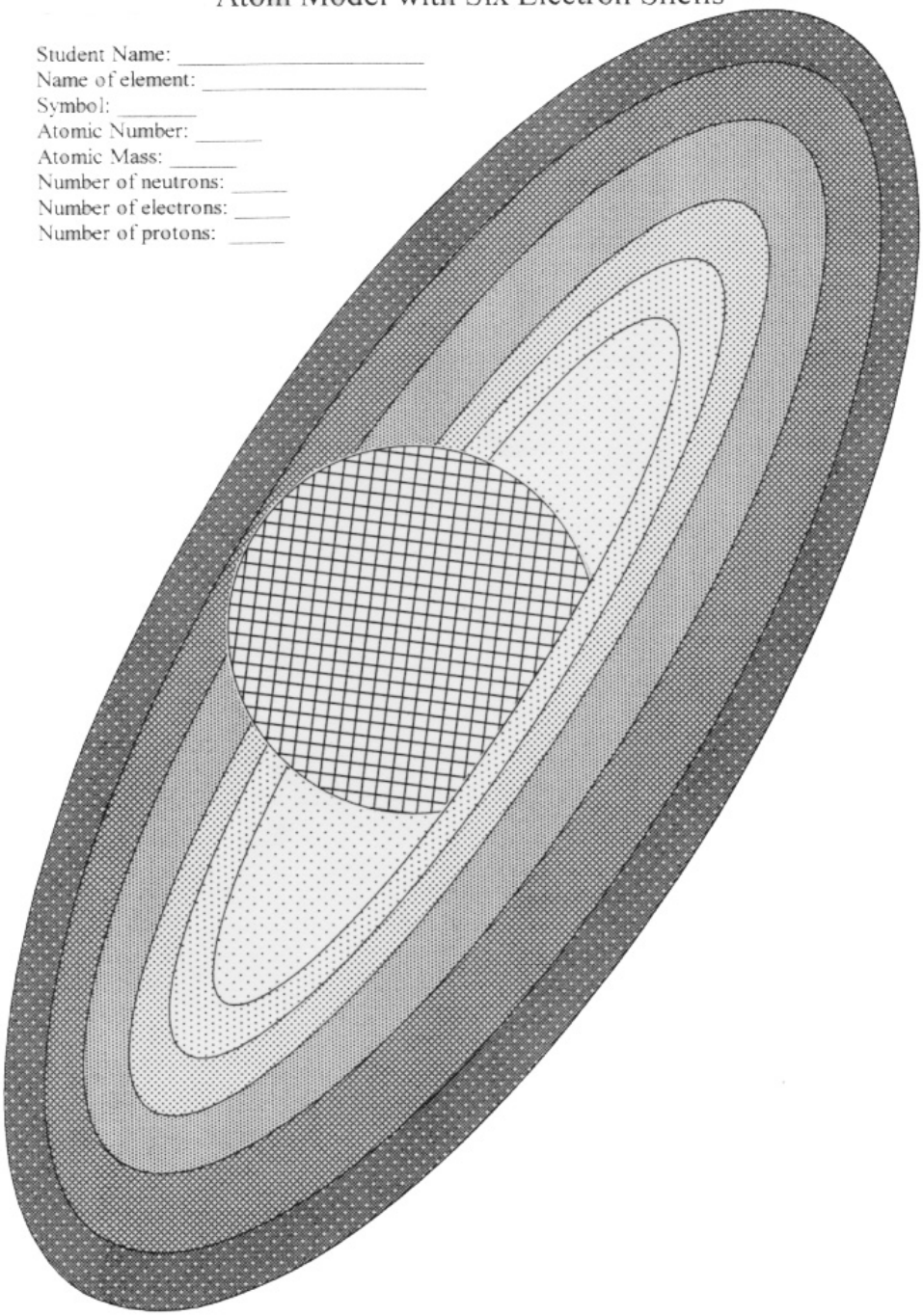
Student Name: _____
Name of element: _____
Symbol: _____
Atomic Number: _____
Atomic Mass: _____
Number of neutrons: _____
Number of electrons: _____
Number of protons: _____



Appendix D-It's All About Matter

Atom Model with Six Electron Shells

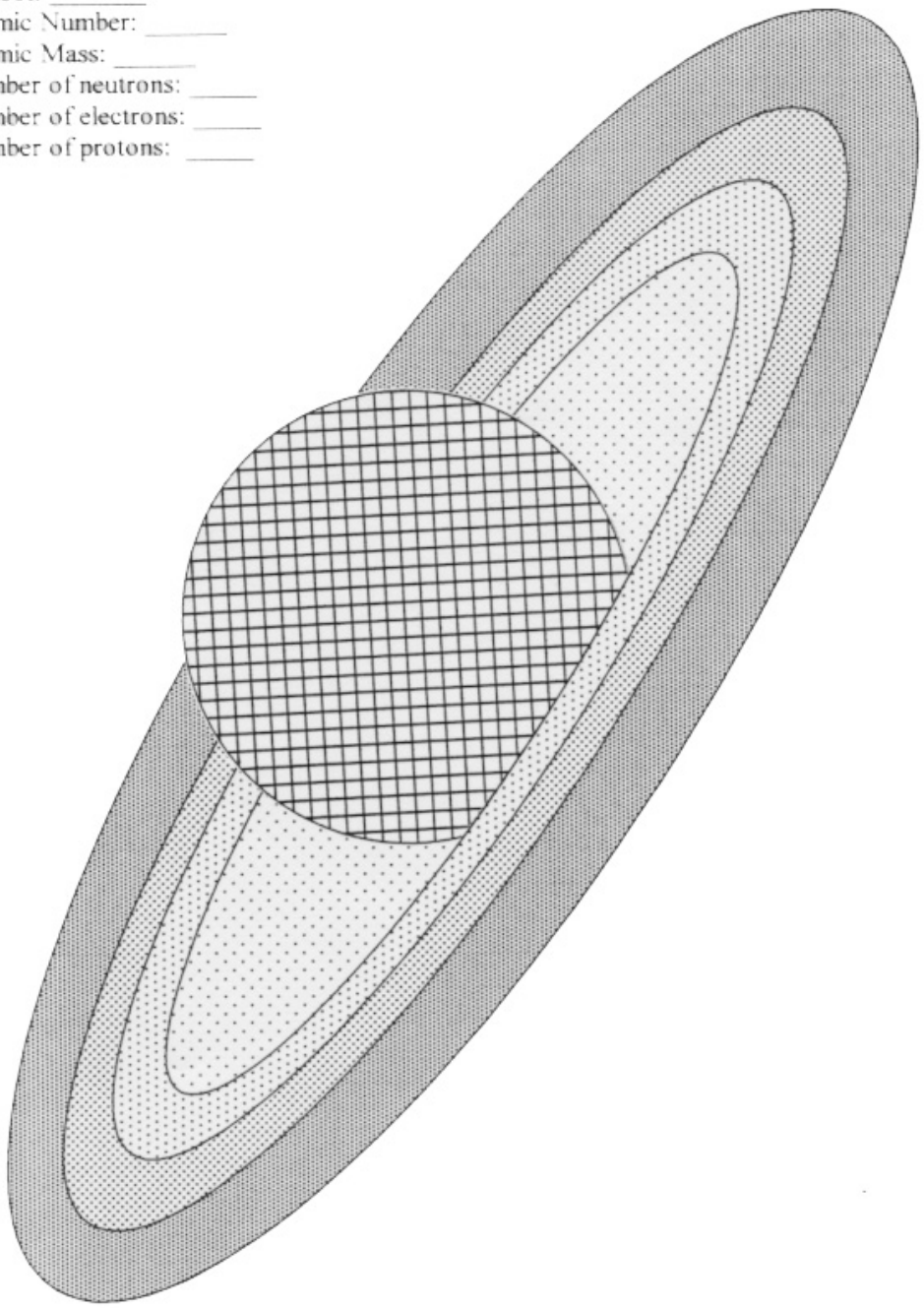
Student Name: _____
Name of element: _____
Symbol: _____
Atomic Number: _____
Atomic Mass: _____
Number of neutrons: _____
Number of electrons: _____
Number of protons: _____



Appendix E-It's All About Matter

Atom Model with Four Electron Shells

Student Name: _____
Name of element: _____
Symbol: _____
Atomic Number: _____
Atomic Mass: _____
Number of neutrons: _____
Number of electrons: _____
Number of protons: _____



Appendix F-It's All About Matter

Atom Model with Six Electron Shells

Student Name: _____
Name of element: _____
Symbol: _____
Atomic Number: _____
Atomic Mass: _____
Number of neutrons: _____
Number of electrons: _____
Number of protons: _____