Acquiring the Foundation:
The Periodic Table for Middle School Science

Annette Boles
Sharpstown Middle School

Chemistry is a traditional course taught in high school and college; however, the foundation of this course should occur in the middle school science classes across the country. So many high school students struggle with chemistry, and as a result they either love it or hate it. The middle school years are still very impressionable years, and the intent of this unit is to get middle school science students to feel comfortable with basic chemistry and its use of the periodic table of elements. The passion for middle school science should transfer to the students; however, it must include the foundation of basic chemistry!

THE UNIT

Acquiring the Foundation presents the periodic table of elements for middle school science students by addressing the basic principles of the periodic table of elements to insure a solid foundation occurs for the middle school science student. This foundation will benefit the middle school student who may or may not enroll in a high school chemistry class. The goal of this unit is threefold. The first is to familiarize students with the history of models of the structure of atoms. The second is to help students understand how the periodic table of elements was organized. The third is to allow students to investigate the history of the different models of an atom and provide understanding of the concepts of the physical properties of the electron. In Krasnow's book he states, "The chemist's most useful tool probably isn't the test tube or the Bunsen burner. It's the periodic table of elements" (8). The periodic table of elements lists all the elements known to man in an order that tells us many things about each element.

The atomic structure of an atom will be introduced in this unit. The students will study the different models of atoms by creating a time line from the early 1800's to the present. The "Acquiring the Foundation" unit will help the middle school student become familiar with chemistry and the periodic table of elements terminology. The unit will explain and demonstrate concepts that answer the following questions: What is a family? What is a period? What is a valence electron? What is an atomic number? The middle school student will get aquatinted with the format of the periodic table. These are only a few of the basic questions this unit will try to answer. However, the basic concept to be conveyed to the middle school student will be the order in which the periodic table of elements is arranged and the relationship of this arrangement to the properties of the electrons within elements. The periodic table of elements is not a random table; the patterns of the periodic table of elements are repetitive just like the days of the weeks and the months of the year.

Haven stated, "I realized nature works in periodic ways, too. In notes, in seasons, in waves at the beach, even in trees: the same characteristics repeat over and over after a set period of time or distance. So I asked myself, "Why not look at the elements for characteristics that repeat?" (113).

The unit will also investigate the basic foundation and principles of chemical bonds. If the middle school science students can understand the organizational concepts of the periodic table of elements and the properties of the electron they will understand periods and groups on the periodic table of elements, valence electrons, covalent bonding, and ionic bonding.

The unit's final project will be an animated periodic table. The student will construct an animated periodic table of the first eighteen elements on the periodic table of elements. The animated periodic table of elements will be organized according to the same principles Mendeleyev used when he placed elements in the original periodic table.

This unit will help students build a strong foundation of the periodic table of elements and the physical properties of the electron. Students will take ownership of basic chemistry because the students will have a firm foundation in one of the most difficult subjects in high school and college. This unit will strive to make laying the foundation of chemistry fun and exciting by breaking it down into layman terms.

THE OPINION

Chemistry is loved by few and hated by many. A chemistry course is filled with positively and negatively charged particles as well as positive and negative opinions. However, the overall public opinion is not a positive one: the general public and science students have a negative opinion about chemistry. What is the origin of this negative opinion? What made the "chosen few" love chemistry? The answers to these questions are one and the same. The opinion of any subject matter starts early in the classroom; chemistry is no different. Science classrooms around the world continue to produce a limited number of great doctors and scientist who have a positive opinion about chemistry. A negative opinion of chemistry is usually formed in the same science classroom where the positive attitude about chemistry began. To insure new opinions of chemistry will form in science classrooms around the world, teachers must pass on the excitement that they have about chemistry to their students. The unit "Acquiring the Foundation" is written to assist middle school science teachers in passing on the excitement of chemistry. "Acquiring the Foundation" provides accurate and exciting activities for the middle school students. The introduction of students to the periodic table of elements should be unique. When students enter the science classroom, it is up to the science teacher to help mold positive attitudes and opinions about chemistry. Middle school science teachers can help prepare the minds of young middle school science students for their first attempt at a high school chemistry course. The objective of this unit is to help middle school science teachers provide an accurate and stimulating foundation for the beginning chemistry student. I believe this unit will help create positive experiences for the pre-chemistry middle school student, which may promote a positive opinion about chemistry.

THE FOUNDATION

This unit is only a small part of the cure for the "Chemistry Blues" that plague our society. "Acquiring the Foundation" was written as an "open" unit. Middle School science teachers using this unit can add to the unit or take away lessons that do not meet their objectives. Hopefully this unit will provide the middle school science teacher with objectives and lesson plans to assist their quest of laying a strong and stable foundation. This foundation for middle school science students will help students understand and navigate the Periodic Table of Elements. Students and teachers must realize the statement by Askew, "The periodic table contains a wealth of chemistry information, if you know how to read it. Freshman physical science students begin learning how to read the periodic table. Chemistry students must expand their understanding of the information on the table." The periodic table of elements is not a table to memorize, but it is a table that provides basic chemistry information. Therefore, every science student must learn how to read and understand the placement of the periodic table of elements.

THE LANGUAGE

One of the most important parts of this unit is accuracy. The language must be correct and comprehended. The language I will use to explain the elements and their properties must be accurate. I will use accurate language to explain how to balance chemical equations using

mathematical skills. I have exhausted websites, textbooks and dictionaries to create the language of this unit. The vocabulary words are a second language to the science teacher, but are a foreign language to the middle school science students. Therefore, we must make the language development a pillar in this foundation that we are creating for our students. It is very important for students to know the language in order to understand how the periodic table of elements is organized. Understanding the language will help students answer questions. There are many questions that are answered with a language of terms that are only found in chemistry and affiliated with the periodic table of elements. The middle school science teacher should not assume that the new science vocabulary is known.

We must take the approach that our students are Limited Science Speaking students. Limited Science Speaking students are students who have a limited science vocabulary. The students may be students in which English is the first or second language spoken in the home. The students have heard science words before, but do they have a working science definition for these words?

IMPORTANT CONCEPTS

Elements, atoms and chemical bonds are all basic concepts middle school science students need to understand before they enter a high school chemistry course in the future. The placement order of elements on the periodic chart helps students understand the atomic structure of each element. Students will know that the number of protons and electrons of an atom is equal to the atomic number on the periodic table of elements. The atomic structure also plays a large part in the bonding properties of each element. The valance electron determines when and how the atom bonds with other atoms. The middle school science students will follow the simple bonding concepts by understanding the principles of the electrons in the outermost electron energy shell. If an atom gains, loses or shares electrons with other atoms, a bond occurs. Bonding concepts, atomic structures and element placement can be understood by the middle school students. If these basic principles of the periodic table of elements are taught to middle school science students, a firm foundation will be prepared for high school and college chemistry courses.

THE ATOM

The history of the atom goes as far back as 430 B.C. People have explained and discussed ideas of the atom down through the ages. Several of these ideas have served as steppingstones for the next scientist in line. Today's model of the atom reflects the in- depth study of the atom and its subatomic particles. Democritus, of Abderin, was one of the first philosophers to consider the concept of the atom.

> His theory was that all matter is made up of tiny building blocks, and that these blocks cannot be divided into smaller pieces. He named the blocks "atomos," meaning "indivisible." This was the origin of the word "atom" that we use today. (Oxlade 8)

Many philosophers tried to disprove Democritus' theory that all matter is made up of atoms. Most Greek philosophers thought all matter was composed of four elements: earth, fire, water and air.

> Eventually most philosophers accepted this idea about four basic elements because two very important philosophers of the time, Aristotle and Plato, supported it. (Oxlade 9)

This popular opinion was promoted and accepted because the two important philosophers believed it; this opinion was just that, an opinion. However, one of the first major breakthroughs for the atom was presented in John Dalton's atomic theory. Dalton's atomic theory states a pure substance is made up of one type of atoms. Many scientists did not agree. They believed one substance was made of many different types of atoms. John Dalton proposed his theory in 1802

based on experiments he conducted in the laboratory. Michael Padilla quotes Dalton as stating, "All atoms of each element are exactly alike (*Chemical Reactions* 43)."

Scientists formulated accurate ideas and theories about the atom based on experimentation without seeing a single atom. The theories progressed because of the experimentation that was taking place in the laboratories of various scientists. Scientists began to construct images and diagrams of the structure of the atom. In 1897 J.J. Thomson discovered a subatomic particle, and he called it an electron. Ernest Rutherford was another scientist who reached conclusions about the atom by conducting experiments in the laboratory. While conducting his experiments he proved that an atom was made of mostly empty space, and the nucleus of the atom contained positively charged subatomic particles called protons. His discovery of the positively charged proton added another dimension to the structure of the atom. In 1947 James Chadwick added the final subatomic particle, thus completing the basic structure of the atom. His discovery was made after he conducted laboratory experiments. He also relied on prior knowledge of other scientists.

The English physicist James Chadwick "found a second kind of nuclear particle. He called it neutron, it has no electrical It simply adds mass to an atom and weighs very nearly the same as a proton" (Gallant 23).

The Chadwick, Rutherford and Thomson discoveries provided a physical yet schematic view of the atom and its characteristics:

> An atom normally has the same number of electrons as protons, so their negative (-) and positive (+) electrical charges are cancelled out, and the atom itself is without an electrical charge. Neutrons do not have a charge. They are packed together with protons in the atom's nucleus. The nucleus makes up nearly all of an atom's mass or weight. (Gallant 24)

THE BOHR MODEL

When using the Bohr model for electron configuration, we will only focus on the first eighteen elements. The Bohr model is used to illustrate the number of electrons found in each energy shell (level). However, we must remember that it is only a model and models have limitations especially for the middle school science student. The limitation of the Bohr model is obvious. It is only two-dimensional and the position of electrons cannot be pin pointed at any given time. Each element on the periodic table of elements has electrons and energy shells (levels). The number of electrons is equal to the atomic number in the elements. For the first eighteen electrons, there are three energy shells (levels) that can hold electrons. In the first eighteen elements, the first energy shell (level) can only hold two electrons. With the two electrons in the first energy shell (level), it is said to be full. The second energy shell (level) can only hold up to eight electrons. With eight electrons in the second energy shell (level), this energy shell (level) is said to be full. The third energy shell (level) can hold up to eighteen electrons; when it reaches eighteen electrons the energy shell (level) is full.

Electrons play a big part in the physical and chemical characteristics of groups of elements. Each family of elements shares chemical properties as they have the same number of electrons in their outer shell; these are called the valence electrons. Teachers must stress to the middle school science student that models have limitations and the Bohr's model of an atom has limitations. The description of electrons in atomic models has changed over the years. Many scientists have submitted different models of an atom down through the years. Models of the atom have gone from two-dimensional to the modern three-dimensional model of the atom. There are several models of the atom that are used by scientist and teachers. Bohr's model has limitations, but it provides a concrete model for middle school science students, and it can be used to describe the

first eighteen elements on the periodic table of elements. Bohr's model gave placement to electrons at different energy shells (level).

> The electrons, however, are not pulled inside the nucleus. They remain in a region outside the nucleus called the electron cloud…Electrons within an atom are arranged in energy levels…The first or innermost energy level can only hold two electrons, the second can hold eight electrons and the third can hold eighteen electrons. (Maton 13)

THE ELEMENT

What is an element? How many elements are there? Where do elements come from? Questions, questions, questions, so many questions. When we introduce this unit to our middle school science students, it should generate question after question. Use these questions to introduce new vocabulary and review old terms. Many people use the word *pure* and it may have the meaning of containing one substance. Therefore, I begin to introduce an element as something that is made of only one thing.

An element is a substance that cannot be "split chemically into simpler substances that maintains the same characteristics. Each of the 103 naturally occurring chemical elements are made up of atoms of the same kind" (Blashfield, *Sparks of Life* 59).

Theoretically if a person could continue to divide an element he would eventually end up with only one atom of the element. Here is a short story--if you hammered out an ounce of gold into a strip of gold, it could be 28 centimeters long and 22 centimeters wide, about the size of a sheet of paper. If you folded the sheet of gold in half and cut it, you would have two halves of gold. If you continued to cut the cut sheet in half, eventually you would end up with one atom of gold.

> That's what makes it an element. All you can do with elements is divide them into smaller pieces of themselves until you get to the smallest piece: an atom. How small is an atom? Trying to understand the size of an atom will boggle your mind. (For the record, it's about .0000000045 of an inch--.0001 microns--across). (Krasnow 4)

How many elements are there? According to the Physical Science book of elements there are one hundred and fifteen elements on the Periodic Table of Elements, and ninety-two of those occur naturally. The remaining twenty-three are created in the laboratory. Most of the synthetic elements are not stable. Therefore, they exist for only a short while. Where do elements get their names? Some of the names of element come from other languages and Greek mythological characters. Who governs the processes of naming the elements?

"The International Union of Pure and Applied Chemistry, standardized the names of the elements and gave each a one- or two-letter code that stands for the name" (Krasnow 5).

THE CHEMICAL BOND

Most elements are found in nature in the form of compounds. The elements possess the unique ability to unite with other things. The bonding capability depends upon the number of electrons in the outer energy shell (level). "Understanding how atoms bond with each other through the sharing or exchanging of electrons advanced the field of chemistry" (Bortz, *The Electron* 43).

This concept has led to the understanding of different chemical bonds. Do elements have the choice to bond? "To bond or not to bond" is a concept about which middle school science students remain confused. What makes an element stable? Does stability affects the bonding of elements? Students can answer these questions understanding the concepts about the configuration of electrons in the outer energy shell (level). More questions will arise about the different chemical bonds elements can create. What are the different types of chemical bonds?

Are all chemical bonds permanent? Scientists have answered these questions by understanding the valence electrons. Valence electrons are the electrons found in the outer energy shell (level) of an atom.

> A chemical bond forms between two atoms when valence electrons move between them. Electrons may be transferred from one atom to another or they may be shared between atoms. (Padilla, *Chemical Reactions* 54)

The valence electrons determine the types of bonds atoms form. Atoms are stable when their outer energy shell (level) is full or more than half full. A full outer energy shell has no room for any more electrons; therefore, it is a stable atom. The atom with a full outer energy shell (level) has no reason to bond with another atom. Atoms are arranged in such a way that each family member shares the characteristic of having the same number of valence electrons. The eighteenth family on the periodic table of elements has a full outer energy shell (level); it cannot hold any more electrons. When the outer energy shell (level) is not full and it has room for more valence electrons, the atom will likely be involved in bonding to another atom. The outer shell (level) will seek to be completely filled. Atoms transfer and share valance electrons:

> An ion is an atom or group of atoms that has become electrically charged. When atoms lose an electron, it loses a negative charge and becomes positive ion. When an atom gains an electron, it gains a negative charge and becomes a negative ion. (Padilla, *Chemical Reactions* 6)

Stability of an atom always depends upon the number of valence electrons. When the maximum electrons are in the outer shell the atom has no need to bond with any thing else. In order for an unstable atom to become stable, it gives up or shares valance electrons.

"In covalent bonding the positive charged nucleus of each atom simultaneously attracts the negatively charged electrons that are being shared" (Maton 21).

A covalent bond is created when electrons are being shared. Ionic bonding occurs when electrons are released from the outer energy shell (level) of one atom and transferred to the outer energy shell (level) of another atom. The elements with fewer electrons in the outer energy shell (level) easily give up the valence electrons. This gives the atom a positive charge. The opposite is true when a partially filled outer energy shell (level) attracts electrons to its outer energy shell (level); it gives the atom a negative electrical charge. Ionic bonding involves the electrostatic attraction of these charged atoms (ions), following the transfer of electrons. When chemical bonds create a new substance is formed and the elements become a compound.

"When scientists finally learned to control electrons, they created a new world of electronic devices unimagined in the early twentieth century" (Bortz, *The Electron* 43).

The first eighteen elements on the periodic table are a great start for any middle school science student to begin. Even though chemistry is traditional course taught in high school and college, the lessons in the unit are presented in days that follow a ninety-minute block schedule. The lessons can be adjusted for forty-five minute classes and lengthened for longer class periods. Basic teacher notes and student worksheets are provided for each lesson. These notes will provide some insight on how the lesson can be taught. The lesson worksheet will address the basic principles of the periodic table of elements for the student. The lessons should help the middle school science student become familiar with the organization of the periodic table of elements, the structure of an atom, and the history of different models of an atom. The middle school years are the impressionable years of every science student; therefore, the student worksheet will allow guided practices and independent practice opportunity for the students. I have included original lesson notes and worksheets in the Appendix. Acquiring the Foundation presents the periodic table of elements in a format for middle school science students to learn the

basics of the periodic table of elements and acquire a foundation for high school teachers and college professors to build upon.

CLOSING

I believe the middle school science classroom is the final place to build a successful science foundation for all of the students in our society. Once our students leave middle school science classrooms, high school science teachers and college professors will build upon the complete or incomplete science foundation of our students. I think today's middle school science teachers have an awesome responsibility to the science discipline and the science students of tomorrow. Middle school science teachers must bridge the gap from middle school science to upper-level science classes; therefore, middle school science teachers must lay a solid science foundation in chemistry and other areas of science. I charge every middle school science teacher to commit to laying a solid science foundation for each student that exit through the doors of middle school science classrooms.

LESSON PLANS

Lesson 1: Periodic Table of Elements

This lesson will help explain what a family and a group is on the periodic table of elements. It also addresses the structure of an atom and the charges of the three subatomic particles. Students will become familiar with the element name, the chemical symbol, the atomic number, the atomic mass, the number of protons, the number of electrons, and the number of neutrons.

Lesson 1A: The Quiz

This lesson will review the concepts covered in the periodic table of elements. The students should remember the information given on the first day of class (See teacher's notes at the end of the lesson plans.)

Lesson 2: My Favorite Alien

This lesson will help the students understand the arrangement of elements on the periodic table of elements. This lesson will help students understand the concept of what an element is and the organization of the elements on the periodic table of elements. The structure of atom and the electron configuration is addressed in the activities of My Favorite Alien. Students will use the same principles used in the first periodic table of elements by organizing the Aliens in the correct families and groups. I have provided a sheet of eighteen Aliens; you can eliminate one or more of the aliens. The students must figure out which Alien is the favorite missing Alien. The Alien lesson has several objectives to meet. The middle school science students will be able to read and understand the periodic table of elements. The students will understand concepts like valance electrons and drawing electron configurations of each atom. With this lesson my students now understand the importance of the periodic table and the atomic structure of atoms and elements.

Lesson 2A: The Giant Table of Elements

This lesson will re-enforce the principles of the periodic table of elements. This lesson can be taught at the beginning of the unit or at the end of the unit for an assessment of the students' understanding of what each square represents on the periodic table of elements.

Lesson 3: A Change in Time

This lesson will help students to develop research skills and create a chronological time line of the model of an atom. The lesson will illustrate the history and development of the atom.

Lesson 4: The First Eighteen and Bohr's Model

This lesson will help students understand Bohr's model of an atom and the electron configuration used in this model, the energy shells (levels), and the valence electrons of the atoms.

Lesson 5: Animated Periodic Table of Elements

In this lesson students will create their animated version of the periodic table of elements. The students can use the aliens for the lesson My Favorite Alien.

NOTES TO THE MIDDLE SCHOOL SCIENCE TEACHERS

The following paragraphs are background notes for teachers to use. The worksheets provide the students with independent and guided practice opportunities. The notes provide facts and concepts that teachers can use while teaching the five lessons provided in this unit.

Each student will receive a copy of the Periodic Table of Elements. You can usually find a copy of the Periodic Table of Elements in your textbook; if you cannot find one to your liking you may go to the Internet and find many different versions of the Periodic Table of Elements. You will need to determine what you want your students to learn from the Periodic Table of Elements before you make your choice. Let your students know that this is their copy, and they should make notes on them to help them understand the order of the Periodic Table of Elements. I use the following notes with my students when I introduce the Periodic Table of Elements.

An element is a pure substance made up of only one type of atom. An atom is made up of three subatomic particles. The proton is the positive charged particle found in the nucleus of the atom. The neutron is also found in the nucleus of the atom, but it is neutral. It does not have an electrical charge. The third particle is the electron, and it is located in the electron cloud surrounding the nucleus of the atom. The above notes may serve as a review for some middle school students. If this is your situation, you may want to skip it or review it. Some teachers may need to elaborate on the atom.

Teachers must emphasize to their students that elements are arranged in the periodic table of elements by increasing atomic numbers. Each element in the chart is located in a square, and each square presents the same type of information. Periodic tables of elements come in all shapes and sizes; therefore, try to find one where each square has the element symbol, the element name, the atomic number and the mass number. It is important for the middle school student to learn how to read and interpret the information of each item in the square.

The elements in the periodic table of elements are not only organized by increasing atomic numbers, they are also arranged by similar characteristics. Based on physical and chemical characteristics, the elements are arranged in families (groups) and periods. Families (groups) are elements arranged in vertical columns. Periods are elements arranged in horizontal rows.

The atomic number is the number of protons found in the nucleus of an atom. All elements have an equal number of protons and electrons. The atomic number reveals to the student the number of protons in an atom has in its nucleus and the number of electrons an atom has in its electron cloud. The characteristic of equal protons and electrons gives the atom a neutral charge. This only changes when an atom loses or gains an electron. An atom can never gain or lose a proton and remain the same element.

An atom becomes negatively charged when it gains one or more electrons in its outer energy level. If an atom loses one or more electrons in its outer shell, it becomes positively charged; if it gains one or more electrons, it becomes negatively charged. An atom that has lost or gained one or more electrons is called an ion.

The mass number of an element is located in the square; the mass number is the sum of the number of protons and neutrons located in the nucleus of an atom. The number of neutrons can be found by subtracting the atomic number from the mass number.

This is basic information you can give your students guided practice to reinforce the concepts from above. You can use The Periodic Table of Elements Worksheet.

Review day with students. Ask for any questions and discuss the Periodic Table of Elements Worksheet. I have made a short quiz for the students. You can decide if you want to give the quiz to the students before or after the review. Today is set aside to discuss and explain electrons. Students can usually understand that protons and neutrons are located in the nucleus. However, they struggle to see that electrons occupy an electron cloud surrounding the nucleus in different energy levels. Please stress to the students that there are several energy levels within the electron cloud and the electrons are not stationary; they move around within the electron cloud. It is impossible to pinpoint where the electrons are at any specific time.

The energy levels within the electron cloud can only hold a certain number of electrons. When one energy level is filled and there are more electrons they will occupy the next level. The next level may or may not reach its capacity, but if it does and there are more electrons they will begin to fill the next energy level. We will only discuss the first eighteen elements in this unit. In the first eighteen elements we have three energy levels within the electron cloud. The first energy level can only hold two electrons. The second energy level can only hold eight electrons and the third energy level can only hold eighteen electrons. The first energy level is closest to the nucleus and the third energy level is farthest from the nucleus. In order for electrons to fill the next level the first level must be filled first and the second level must be fill next and then the third level. However, not all energy levels are used. Some energy levels are used, but never reach their capacity. For example the element Lithium has three electrons. The first energy level is full with two electrons. The second energy level never reaches its capacity because lithium only has one electron in the second energy level. This energy level is far from being filled.

Valence electrons are the electrons that are in the outer energy level of an atom. When the outer energy level is not filled the atom can gain, share or lose electrons. An element will try to fill its outer energy level by losing, gaining or sharing an electron. This information should help your students complete the My Favorite Alien activity.

APPENDIX

Name: _____

Class: _____

Date: _____

PERIODIC TABLE OF ELEMENTS WORKSHEET

1. Look at your Periodic Table of Elements and find the element Aluminum, in the space provided below draw the square and label it. You must include the atomic number, the symbol, the element name and the mass number.

2. What is a family? _____
3. What is a period? _____
4. What three subatomic particles make up an atom? _____

   _____
5. What are the charges of the three subatomic particles and where are they located within the atom? _____
6. Why are atoms neutral? When do atoms become electrically charged? _____

   _____
7. List the elements that belong to the second period on the Periodic Table of Elements. ___
8. What is an ion? _____

   _____

9. Use your Periodic Table of Elements to fill in the table below for the first ten elements.

Element Name	Chemical Symbol	Atomic Number	Atomic Mass	# of Protons	# of Electrons	# of Neutrons

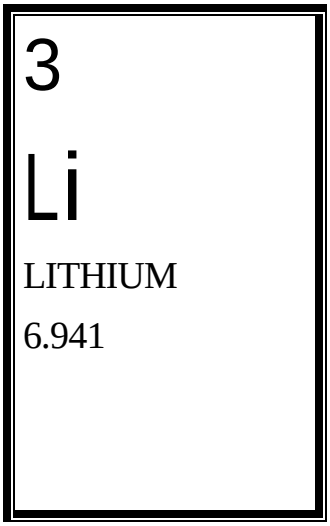
Name: _____

Class: _____

Date: _____

QUIZ PERIODIC TABLE OF ELEMENTS

Label the square below with the correct term.



1. _____
2. _____
3. _____
4. _____
5. How many protons does this element have? _____
6. How many electrons does this element have? _____
7. How many neutrons does this element have? _____
8. What subatomic particle does the atomic number represent?_____
9. What two subatomic particles combine to make the mass number? _____

_____

10. Why are atoms neutral? _____
11. What is an ion? _____

MY FAVORITE ALIEN

Objectives:

1. The student will be able to discuss and explain what a family and a period are on the Periodic Table of Elements.
2. The student will be able to correctly arrange the Aliens in the proper families and periods based up on the Periodic Table of Elements.
3. The student will be able to identify the number of electrons in the three energy levels of each Alien.
4. The student will be able to explain and define an ion.
5. The student will be able to define and explain a valence electron.
6. The student will be able to interpret and explain any square on the Periodic Table of Elements.

Problem:

The yearbook staff at Sharpscity Middle School has a problem completing their 2005 yearbook. They have lost the yearbook picture of My Favorite Alien. They cannot retake the picture of My Favorite Alien. My Favorite Alien has left the Galaxy. However, there are pictures of other Aliens. You must arrange the pictures of the remaining Aliens. The pictures must be in order. The only clues you have are found on the Periodic Table of Elements. Use it to figure out which Alien is missing. You must use the characteristics of the remaining Aliens to draw the portrait of My Favorite Alien. The portrait must fit in the sequence of the remaining Aliens.

> You see how simple it is? In each square there is a space for an element whose weight, valence, and characteristics are known by its column and row, or family, on the table. "These three holes here," Dmitri stabbed dramatically with his finger at three blank spaces on the chart. "These are the three missing elements I know will be discovered someday." (Haven 114)

Procedures:

1. Read the letter from Sharpscity's yearbook editor.
2. Study the pictures of the seventeen Aliens.
3. Cut out the Aliens and arrange them into families and periods.
4. Study the physical characteristics of each Alien before you arrange them in families and periods based upon the Periodic Table of Elements.
5. Leave an open space for My Favorite Alien's portrait that was lost.
6. Get permission from your teacher before you glue the Aliens in the correct order. Use your Periodic Table of Elements to help you place the Aliens in the correct order.

7. Once you have glued the remaining Aliens in the correct order, draw the missing portrait of My Favorite Alien. The portrait must be similar to the surrounding Aliens.
8. Complete My Favorite Aliens by labeling each Alien with the element name from the Periodic Table of Elements.

Note: This lesson was adapted from a lesson titled "My Missing Cousin" lab found in a TAAS student guide to prepare students for the Texas State Exam.

Materials:

1. Glue
2. Scissors
3. Construction paper
4. Alien pictures
5. Pen/pencil
6. Editor's letter
7. My Favorite Alien questions

Dear Student Body,

We have a problem, and the yearbook staff is in a panic! The Sharpscity Middle School yearbook staff may miss the printing deadline. The deadline is approaching fast and we need all the help we can get. We need your help to complete our exchange student section. We have completed all of the other sections of the yearbook; however, the exchange student's section is not finished. This year our exchange students were far out. They came from the distant galaxy Andomeda. The eighteen Alien exchange students have unique physical characteristics and behavior made them a close-knit group. We had eighteen Alien exchange students. However, we only have photographs of seventeen Aliens. We are missing the photograph of My Favorite Alien. Most of the Aliens were from the same families. Their physical features and clothing are similar. We need someone to create a portrait of the missing Alien. The missing Alien was Sharpscity's favorite. I have included the pictures of the seventeen remaining Aliens. Arrange the pictures of the seventeen Aliens in their families according to their clothing and arrange them in periods according to their physical characteristics. If you can do this, you will be able to determine where My Favorite Alien fits in. Please draw the portrait of the missing Alien to help us complete the exchange student's section of the yearbook. Please help us meet the deadline.

Inita Lions,

Yearbook Editor

Name: _____

Class: _____

Date: _____

MY FAVORITE ALIEN

1. What is the name of the fifteenth Alien? _____
2. What is the atomic number of the tenth Alien? _____
3. How many Alien families are represented? _____
4. To which Alien family does My Favorite Alien belong? _____
5. How many electrons does it take to fill the 1^{st}, 2^{nd}, and 3^{rd} energy levels?

   _____
6. How many electrons are in each level for Alien thirteen? _____
7. Please explain why some Aliens are smiling and some are frowning? _____

   _____
8. What is a valence electron? _____
9. What is the valence electron for Alien eight? _____
10. What is the valence electron for Alien six? _____
11. List all of the Aliens that have a full outer energy level. _____

    _____

    _____

    _____

    _____
12. What two things helped you place each Alien in a family? _____

    _____

    _____
13. Can you draw a picture for the nineteenth Alien if there was one? Draw a portrait below. Include everything that other Alien family members have.

Name: _____

Date: _____

Class: _____

A CHANGE IN TIME: MODELS OF THE ATOM

Purpose:

To make a time line of the different models of atoms used by scientists to understand the behavior of the electrons and the atom itself.

Objectives:

TLWBAT research the history of the models of the atoms used in chemistry.

TLWBAT write a short paragraph about the scientist and the model of the atom that he submitted.

TLWBAT place the model of the atom on a chronological time line from Democritus to the present day model of the atom.

Procedure:

1. Students will research the following scientist: Democritus, Dalton, Thomson, Nagaoka, Rutherford, Bohr and the modern day atom.
2. In their written research students must include: full name of the scientist, year the scientist submitted his model of the atom, name of the model, country the scientist is from, summary of the scientist's theory of the atom, and a picture of the scientist.
3. Students must create a numeric time line using adding machine tape and place the scientist's name and a picture of their model on the time line in chronological order. Students must include the year the model was submitted.
4. Students will present their findings to the class.

THE GIANT TABLE OF ELEMENTS

Teacher Note:

This lesson can be used to introduce the students to the periodic table of elements or as a review.

Purpose:

To create a life-size periodic table and familiarization with the periodic table of elements.

Objectives:

TLWBAT create a life size periodic table of elements.

TLWBAT organize the periodic table of elements according to families and periods.

TLWBAT define and explain families and periods on the periodic table of elements.

TLWBAT identify the atomic number, chemical symbol, element name and the atomic mass of an element on the periodic table of elements.

TLWBAT explain how to read the periodic table of elements.

TLWBAT identify metals, nonmetals and inert gases on the periodic table of elements.

THE GIANT TABLE OF ELEMENTS

Materials:

1. A large blank wall to hang the giant periodic table of elements
2. A copy of the periodic table of elements
3. Markers: red, black and blue
4. Seventeen sheets of 28 cm x 22 cm orange construction paper
5. Seven sheets of 28 cm x 22 cm purple construction paper
6. Eighty-eight sheets of 28 cm x 22 cm green construction paper

Procedure

1. Place students in eight groups.
2. Give each group a copy of the periodic table of elements.
3. Assign each group fourteen elements; groups can be in order or random.
4. Orange construction paper is for nonmetal elements.
5. Purple construction paper is for inert gases.
6. Green construction paper is for metal elements.
7. Black marker is for solid elements.
8. Red marker is for gas elements.
9. Blue is liquid elements.

10. Each sheet of construction paper represents the element box on the periodic table of elements. The element box must include the atomic number, element name, chemical symbol and the atomic mass. Remember the correct colors your markers.
11. When the groups have completed their elements boxes, the teacher will laminate the sheets.
12. Each group will attach and arrange their elements on the wall according to increasing atomic numbers.
13. The teacher will draw a zigzag line that separates the metals from the nonmetals.

Observation:

Answer the following questions:

1. What is the largest group of elements on the periodic table of elements?
2. List the gases on the periodic table of elements.
3. List the elements on the periodic table of elements that are liquid at room temperature.
4. What are a family and a period on the periodic table of elements?
5. List the nonmetal elements that are not gases on the periodic table of elements.
6. List the names of the elements that have the following atomic numbers: 2, 3,10,20 and 36.
7. List the names of the elements that have the following chemical symbol: He, Au, Hg, Li, C, O, and Cu.
8. Fill in the chart below:

Element Name	Chemical Symbol	Atomic Number	Atomic Mass	Phase of Matter
	Hg			
		36		
Silver				
			4.003	
		54		
Americium				

Name: _____

Date: _____

Class: _____

THE FIRST EIGHTEEN ELEMENTS

The periodic table of elements has grown from the sixty-three elements Dmitri Mendeleev discovered in the 1800s to one hundred and eighteen elements. However, we will only focus on the first eighteen in this activity using the Bohr's model of an atom.

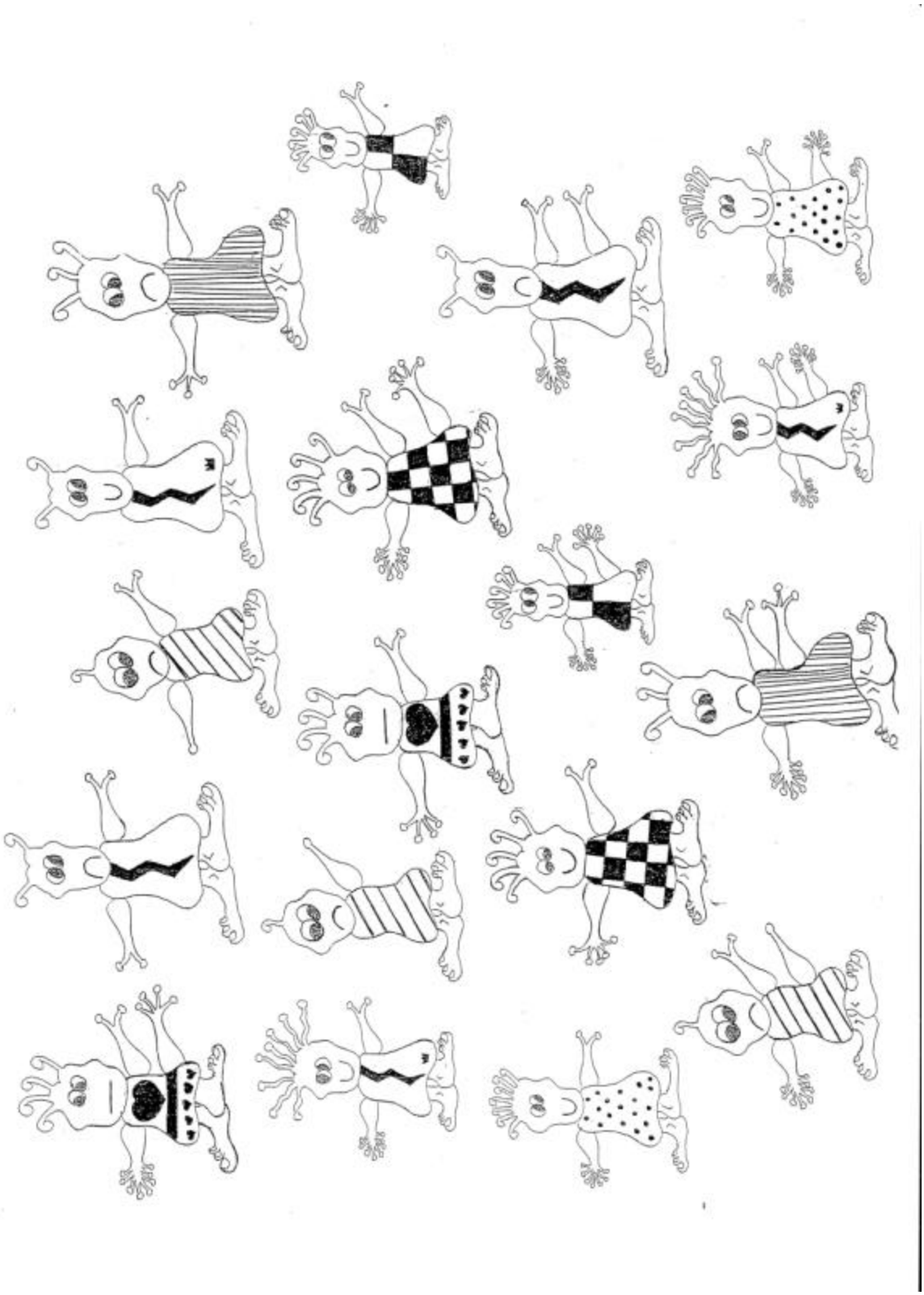
The First Eighteen Elements

Complete this chart for the first eighteen elements on the periodic table of elements.

Element Name	Symbol	Atomic Number	# of Electrons	1st energy shell	2nd energy shell	3rd energy shell
Neon	Ne	10	10	2	8	0
			2			
		13				
	S					
			1			
				2	8	8
Fluorine						
		11				
	Li					
Oxygen						
		4		2	3	0
			14			
Nitrogen						
	Cl					
		12				
			6			
				2	8	5

Answer the following questions

1. Place the first eighteen elements in the correct families.
2. How many families are represented with the first eighteen elements?
3. Which elements have eight electrons in their outer shell (level)?
4. Which elements have one electron in their outer energy shell (level)?
5. How many electrons does Oxygen have in its outer energy shell (level)?
6. How many electrons does Lithium have in its outer energy shell (level)?
7. Look at the first eighteen elements. Which element is an exception to the rule that the number of electrons equals the atomic number of an element?



ANNOTATED BIBILIOGRAPHY

Works Cited

Askew, Jim. *The Periodic Table*: *Chemistry Week* 03. Howe, Oklahoma, 2002. <http://www.howe.k12.ok.us~jimaskew/chem/ctable.htm>
A website of Howe High School's Chemistry curriculum.

Blashfield, Jean F. *Sparks of Life: Hydrogen*. Austin: Raintree Steck-Vaughn Publishers, 1999.
A good resource for a guide to reading the Periodic Table.

Bortz, Alfred B. *The Library of Subatomic Particles*: *The Electron*. New York: The Rosen Publishing Group, Inc., 2004.
Presents the story of the discovery of the first subatomic particle and how it revolutionized understanding of the atom in chemistry and led to new field of electronics.

Gallant, Roy A. *The Ever-Changing Atom*. New York: Marshall Cavendish, 2000.
A book that explains the history of atoms and the great thinkers of long ago.

Haven, Kendall. *Marvels of Science 50 Fascinating 5-Minute Reads*. Englewood, Colorado: Libraries Unlimited, Inc., 1994.
A great book for teachers to read quick real life events about science and great scientist. The readings could be used for warm up activities or zingers.

Krasnow, David, and Tom Seddon. *Physical Science Elements*. Milwaukee: Gareth Stevens Publishing, 2003.
Presents information and instructions for activities related to chemical elements found on Earth and in outer space.

Maton, Anthea. *Annotated Teacher's Edition Prentice Hall Science Chemistry of Matter*. Upper Saddle River, New Jersey: Prentice Hall, 1994.
This book provides the teacher with background knowledge about atoms and basic chemistry.

Oxlade, Chris. *Chemicals in Action: Elements and compounds*. Chicago: Heinemann Library, 2002.
This book introduces the reader to elements, atoms and the Periodic Table.

Padilla, Michael J. Ph.D. *Prentice Hall Science Explorer Chemical Reactions*. Upper Saddle River, New Jersey: Prentice Hall, 2002.
This book provides background information about chemical reactions and atoms.

Supplemental Sources

Blashfield, Jean F. *Sparks of Life*: *Oxygen*. Austin: Raintree Steck-Vaughn Publishers, 1999.
A resource book on the history of Alchemy and the element Oxygen.

Bortz, Alfred B. *The Library of Subatomic Particles*: *The Neutron*. New York: The Rosen Publishing Group, Inc., 2004.
A look at the discovery of the neutron, which completed our picture of the structure of the atom and enabled us to explain the existence of isotopes and understand how nuclear fission, occurs.

Hasan, Heather Elizabeth. *Understanding the Elements of the Periodic Table*: *Nitrogen.* New York: The Rosen Publishing Group, Inc., 2005.
A book for students to use as they take a closer look at the element Nitrogen.

Padilla, Michael J. Ph. D. *Science Explorer Grade 8*. Upper Saddle River, New Jersey: Prentice Hall, 2002.
A great textbook for eighth graders used by the district I teach in.

---. *Science Explorer Grade 6*. Upper Saddle River, New Jersey: Prentice Hall, Inc., 2002.
A great textbook for sixth graders used by the district I teach in.