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Chemistry For Everyday Living

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Introduction

My chemistry unit is being written for high school special education students. The students placed in my classroom will have a wide variety of disabilities, mild mental retardation, social and emotional problems, as well multiple learning disabilities. There are at least 109 specific learning disabilities. Students can possess one or many of these identified disabilities.(1)

The average class size is 16 students with one teacher and no teaching assistants. I highly recommend collaborating with volunteer groups and Universities to recruit adult volunteers to help students work with group problem solving activities. I have done these activities in my classroom both with and without adult volunteers. I have found students produce much better work when more adults are available to give the students encouragement and feedback on the progress of their projects.

This unit will introduce basic concepts in the properties of matter, the periodic table, and atomic structure. The students will engage in hands-on activities to help develop an understanding of abstract concepts. Students will be asked to explain changes in matter using scientific vocabulary learned during the unit.

It is important to remember that students with severe disabilities often do not believe their ideas are worth testing. For the majority of their school career they have watched their peers master subject matter which seemed beyond their capabilities. We must be careful not to make “mastering the content material” more important than “belief in one’s ability to make sense of one’s world”.

Objectives

To develop language skills needed to engage in scientific investigation.

To develop the social skills necessary to engage in collaborative problem solving.

To develop an understanding of the role chemicals play in our everyday lives.

What is Chemistry?

Before starting a new unit it is important to assess what your students already know about the topic. This will help to determine the level of your students' understanding of chemistry, as well as identify misconceptions students might have internalized. I will begin my unit with a short brainstorming activity. Each student will be given a science journal to record observations, draw diagrams, and keep class notes. I will ask students to write the word chemistry on a clean sheet of journal paper. I will also do this on the blackboard. Students will be asked to tell what they think of when they hear the word "chemistry". Record all words and phrases. Encourage student involvement. Ask questions, give clues, do not allow them to tell you they know nothing. Students will be asked to repeat this activity at the end of the unit to illustrate growth in content understanding as well as scientific vocabulary. Students will be required to copy the responses from the board onto their paper. This exercise should also promote reading and writing skills. Have students focus on the phonetic break down of the words. Validate all student responses, while emphasizing that chemistry is the study of everything they touch, taste, see or smell. Everything is made of chemicals, even invisible things such as air.

To further assess my students' understandings of basic chemistry concepts, and to encourage scientific observation skills, I will set up the following demonstrations and ask my students to explain what they observe. All four demonstrations should be done in one class period to generate enthusiasm and curiosity for the topic they are about to study. Have another adult or student photograph each step of each demonstration. This will be used at a later date for students to display scientific explanations of each exercise.

1. The students will be shown a ball of clay and a ball of steel. Smash the ball of clay into a flat pancake shape. Attempt to do the same to the ball of steel. Ask the students to propose in writing and or diagrams why the clay ball could be flattened, but the steel ball could not. Ask them to imagine they could see the smallest parts of these balls through a very powerful microscope. What would they have observed ?

2. Place one tablespoon of salt into a beaker of water and stir. Place one tablespoon of cornstarch into a second beaker and stir. After stirring, the container with cornstarch is cloudy, and the container with salt is clear. Ask the students if they could see the smallest particles in each container, what do they think they would they be seeing? What is the difference between the containers?

3. Place an ice cube into a beaker and heat slowly on a hot plate until the ice melts and evaporates. Next, heat a piece of dry ice in the same manner. The dry ice will change to a "white cloud". Ask the students to explain why dry ice behaves differently? Ask the students what they think happened inside each piece of ice during the heating process? And what do they think the "white cloud is made of?

4. Place a teaspoon of baking soda into a beaker. Add a small amount of vinegar. The students will see bubbles. Ask students if they had a powerful microscope that would allow them to see the smallest particle of each substance, what they think they would have seen before and after the vinegar was added?(2)

Depending on the severity of my students' disabilities, I may want to put your students into groups for this exercise and allow the students to submit one explanation for the group. It would be preferable to have each student write or diagram his or her own response. If you have some higher level students who finish early, they can act as secretaries for students who have difficulty writing. This would enable each student to have his or her own response, which can be used as a self- assessment tool later in the unit. Each student will be able to measure growth against one's own past performance, not the performance of his or her peers.

It is important for the teacher to read the student's science journal and make encouraging comments on a regular basis. Students will quickly lose interest if they realize I do not have the time to keep up with their journal responses. Time should be given during class for journal responses. This must be seen as an important activity that warrants class time. Students should be allowed to collaborate and discuss ideas when writing. The teacher must circulate around the room to insure students are not merely copying each other's work. This is also a time when the teacher can collaborate with individual students.

After students have finished writing and drawing in their journals, explain that scientists pondered these same questions for thousands of years before they decided what really happened to this matter. Scientists are men and woman who answer questions through observation, experimentation and data collection. Explain to your students that they have just taken the first step in becoming a scientist. Many great scientists have spent their entire life trying to answer similar questions.

After I have covered content information on the topics of density, dissolving, phase change, and chemical reactions, I will ask students to repeat the above exercise. I may repeat the above demonstrations or create a display of before and after photographs for the students to view before they write in their journal.

Student responses in demonstration 1 should include references to density, molecules being packed closer together, stronger bonds holding the atoms together, or the need for heat or chemicals to separate certain bonds. Remind students that substances can be strong without being dense. The atoms in clay are bonded in layers which allow the material to slide. Steel atoms are bonded in all directions.

Demonstration 2 should include responses such as "the salt molecules are separating in the water, and the starch seems to be thickening in the water, changing the appearance of the water. (I would leave this experiment out so students can see what material is left after the water evaporates. I would also encourage students to experiment with mixing both salt water and starch and water to different consistencies to observe each more closely.)

Demonstration 3 should include responses such as "The heated ice cube demonstrated all three phases of water. The dry ice skipped the liquid stage." Then I would ask the students to try to come up with explanations for why it skipped the liquid stage. When students have devoted sufficient time to the question I will supply them with reference materials where they may search for the answer individually or as teams. The "white cloud" is actually water droplets. Similarly, when you see someone's breathe on a cold winter's day you are actually seeing water droplets in the air.

Demonstration 4 should include responses such as, two compounds came together in a chemical reaction and formed a new compound, or a gas was produced when baking soda reacted with vinegar.

Allow each team enough time to find the answer themselves. Do not become impatient and give the answer. Students who require more time will lose motivation to find answers on their own if they are not given the appropriate time they need. If I have a student with severe processing disabilities, I will sometimes give them the problem solving assignment before the other students. The rest of the class may be working on individual research projects. When we come together for our group problem solving, the student with processing disabilities will be able to keep up with the group. (This is an important life skill for students with disabilities. They must learn how to make requests for modifications when appropriate to insure success. Proficiency in a career does not always require speed over accuracy.) If given the choice to nurture thoughtful, time consuming, inquiry-based exploration, or finishing the content in the textbook, I will always choose the inquiry-based exploration, especially for the special education student.

Historical Overview

Related Vocabulary

Before presenting the historical overview students should read the following vocabulary from the board aloud. The vocabulary should be explained and discussed by the teacher. Students should than copy the vocabulary into their science journals. Tell students they should study the vocabulary for homework. They will be asked to explain the meanings of each word during the next class. I will start by telling students the definition and asking them to find the corresponding word. Mastering this vocabulary will most likely not take place in one day. Vocabulary review will take place the first ten minutes of every class. I ask for volunteers rather than call on students. I have no problems finding students to volunteer. Students become accustomed to daily vocabulary reviews and are interested in eventually mastering all the words. I emphasize the importance of becoming scientifically literate and informed citizens.

has

1. matter: anything that mass and volume.
2. element: simplest type of pure substance.
3. atoms: smallest particle of an element that has characteristic properties of that element.
4. alchemist: a chemist who lived during the middle ages, whose primary goal was to transform matter into gold. They often stressed secrecy rather than clarity. They are the forefathers of experimentation. They were the first to use what is known today as the scientific method.
5. pharmaceutical: of pharmacy or drugs.
6. by-products: anything produced in the course of making another thing.
7. philosopher: during the early 1800’s it meant “scientist”. Today it means a person who studies the principles underlying conduct, thought, and the nature of the universe. One who loves knowledge.
8. Indivisible: cannot be divide any further.
9. Theory: a formulation of underlying principles of certain observed phenomena which has been verified to some degree.

10. hypothesis: an unproved theory.

Ancient Greek Philosophers argued over what they believed to be the nature of matter. They believed the world was far more simple than it appeared. A philosopher named Leucippus theorized that all matter was essentially composed of one simple substance. In about 400BC another Greek philosopher, Democritus, named this simple substance “atoms”, which meant “uncuttable”. Their theory was that if matter was repeatedly cut into smaller and smaller pieces, it would eventually result into a piece that could no longer be cut. This theory about matter remained the same for hundreds of years. Scientific investigations into the behavior of matter began by a group of people called Alchemists who wished to transform everything imaginable into precious metals, such as gold and silver. They also tried to manipulate matter into potions that would allow people to live forever. These early scientists actually studied problems and created experiments to test their theories.(3)

Today’s scientists continue to investigate chemistry concepts in order to explain the many events we observe in our daily lives. Pharmaceutical companies continue to search for medicines to keep us living longer, cosmetic companies search for creams and potions to slow down or disguise the aging process in our bodies, and government agencies are working on new ways to recycle the by-products of human activities. Who would have guessed that such a simple concept as “all matter can be broken down into a single indivisible substance called the atom”, would have opened the doors for such complicated research and discoveries that we see today.

After introducing the historical overview, students will view the Nova video Kaboom. This video shows modern day scientists replicating experiments from the journals of ancient alchemists.

Teaching Strategy

At this point before starting your content teaching, be prepared to assign research topics to higher level students. Develop a list of important scientists in the field of chemistry for the student to choose from. Your list may include the following scientists: Priestley, Lavoisier, Boyle, Liebig, Dalton, Newton, Mendelelyev, Avogadro, Berzelius, Boltzmann, Mamma Curie, C.W. Leadbeater, and Pasteur. Make it clear to these students that they are to work on their independent research when ever they finish their assigned class work. Bright students can turn into behavior problems when allowed to become bored in class. I usually collect related books to keep in my classroom. My school librarian has also developed lists of related books available in our school library for use by my students. It is an extremely open ended assignment. Students are asked to give a class presentation upon completion of their research. Some students spend long periods of time on visual aids. Other students produce long narratives. If the student needs assistance with their presentation I allow other students to help. For instance a poor reader may have a student reads certain parts of their research during their presentation. I have also acted as an assistant to extremely shy students. Any interested student can participate. I also help the students to find related educational videos and classroom speakers to help stimulate interested in the particular topic presented. Students always take great pride in their independent research projects. I have never had a student who has not wanted to present his of her work to the class. If all the students become interested in this project it may be wise to break the class into research teams.

Matter

Related vocabulary

11. inertia: the property of a material that resists any change in its state of rest or motion.
12. density: the scientific way of comparing the "heaviness" of materials. It is the measurement of the mass of a specified volume.
13. physical property: characteristic that distinguishes one type of matter from another and can be observed without changing the identity of the substance.
14. chemical property: property that describes how a substance changes into a new substance.
15. gravity: the force that pulls objects on the earth toward the center of the earth. The pull of gravity on an object determines the object's weight.

Matter is the substance that all things are made of. Everything you see around you is made of matter. It may have very different physical and chemical properties, but all matter takes up space and has inertia and mass.

Mass is the amount of matter in a given object. Mass does not change. The mass of a person is the same on the earth or the moon. The weight of that same person will change due to the change in the gravitation pull of each planet. The amount of mass in an object is constant. Weight is not a constant. Although an object in space is said to be weightless, it is not massless.

Mass is a measure of the inertia of an object. Inertia is the resistance of an object to changes in its motion. Objects at rest need force to move them. Objects in motion need force to stop or change movement. A marble resting on a desktop will not move until a force, such as your hand, is used to move it. That same marble in motion will need a force to stop it from rolling down a ramp. If we replace the marble with a bowling ball it will require more force to start or stop its motion, than was required for the marble. The more mass an object has the greater its inertia.

Matter takes up space. The amount of space an object takes up is called its volume. Liter, milliliter, and cubic centimeter are the metric units used to express volume. In general, liters and milliliters are used to measure liquids and cubic centimeters are used to measure the volume of solids.

Density is the mass per unit volume of an object. All matter has density. The density of a specific kind of matter is the property that helps to identify it and distinguish it from other kinds of matter. Density of an object is the amount of matter in a given amount of space or volume.

Related Activity

To demonstrate the different densities of liquids.

Materials: 1 tall, clear container, 1 grape, 1 cork, I plastic building block, water, cooking oil, and syrup.

Procedure: *Pour the syrup into the container

*Slowly pour in the same amount of oil. It floats on the syrup.

*Add the same amount of cold water. It sinks through the oil but floats on the syrup.

*Put the cork, plastic block, and the grape in the container.

*The objects float at different levels because they have different densities.(4)

Matter can exist in four phases: solid, liquid, gas and plasma. The plasma phase is extremely rare on Earth. The particles of any substance are constantly in motion. The type and extent of the motion determines whether the substance is a solid, liquid, or gas. Matter in the solid phase has less energy than matter in the liquid phase. Matter in the liquid phase has less energy than matter in the gas stage. When we add heat energy to liquid matter it will change to gaseous matter. When we take heat energy away from gaseous matter it will turn into liquid matter. If we continue to take more energy away the liquid matter will turn into solid matter.

Related Activity

To demonstrate the three phases of matter.

Materials: hot plate, sauce pan or other heat resistant container, two trays of ice cubes, and a large shallow baking pan .

Procedure: *Place ice cubes from one ice tray in sauce pan over hot plate.

*Place ice cubes from second tray in baking pan.

*As water in pan begins to boil place pan with ice above the boiling water.

*Heat from the hot plate will change the solid ice into water vapor, which will condense back into a liquid when it hits the cold, iced pan.

Solids have a definite shape. Their molecules are packed close together. Solids do not flow or move far apart. Solids can only vibrate. The internal structure of a solid is arranged in a regular, repeating pattern called a crystal. These solids are called crystalline solids. Amorphous solids are solids that lose their shape under certain conditions such as candle wax, or tar used to repair roads.

Liquid particles are close together but not as close together as particles in the solid stage. Liquid particles are free to move from one place to another, but the forces of attraction keep the particles close together. Liquids do not have a definite shape but they do have a definite volume.

The gas phase does not have a definite shape or volume. A gas fills all the available space of the container. Particles of a gas can be pushed close together as well as spread far apart. If allowed to gases will expand without limit. The gravitational pull of our planet holds our atmosphere close to the surface of the planet. Without this gravitational force holding the atmosphere, the gases would spread throughout the Universe.

Gas molecules are in constant motion. They move around at high speeds constantly hitting one another and the sides of their container. The more heat you add to the gas molecules the faster they will move, and spread apart. (5)

Related Activity

To demonstrate the expansion of gas molecules when heated.

Materials: 1 large empty metal olive oil container cleaned thoroughly, enough water

to fill ½ inch of the bottom of container, hot plate, the screw-on top to the

container, Oven mitt.

Procedure: *Fill water to fill ½ inch of the bottom of the container.

*Once you hear the water begin to boil, turn off the heating element.

*Using the oven mitt, place the top on the oil container and secure it

tightly. If the plastic seal on the spout breaks or cracks due to the

pressure from the water vapor, it will necessary to start over with a

new oil container.

Results: Within 5 minutes the can should begin to crush. The expanding water

vapor has pushed all the air out of the can. As the temperature inside

the can begins to cool, the water vapor condenses back into water. A

vacuum is formed. (6)

Behavior of Water Molecules

Water is one of the few compounds on Earth that can be naturally found in all three states. A major difference between each of these states is density, or how closely the water molecules are packed together in a given area. Water vapor is the least dense because of the large space between the molecules.

Heating and cooling water affect the density of water. Heating water speeds up the movement of water molecules. When the movement is increased the molecules are less likely to stay close together. Therefore warm water is less dense than cold water.

Related Activity

To demonstrate that warm water is less dense than cold water.

Materials: Large glass tank or bowl, Small bottle with cap, water, ink or food

coloring

Procedure: *Pour cold water into the tank until it is about three quarters full.

*Fill the bottle with hot tap water. Add a few drops of coloring.

*Screw the cap back on the bottle and shake it well.

*Place the bottle on the bottom of the tank and unscrew the cap.

*The hat water from the bottle is lighter, or less “dense,” than the cold water, so it shoots to the top of the tank.

*The hot colored water forms a layer on top of the cold water. As it cools, the colored water mixes with the cold water.(7)

If cold water is denser or heavier than warm water than how does an even colder water called “ice” float in water? Give each group of two students a container of water and two ice cubes. Ask students to observe these two phases of water and hypothesize as to why the ice floats in liquid water. They should write their ideas in their science journal and diagram the floating ice.

Related Activity

Draw a diagram on the board of a water molecule. Diagram molecules as you might think they would look like as a liquid. Spread them even further apart to represent a gas. Ask the students to guess how they think the molecules would look when the water is frozen. Students will build their own water molecules to represent the solid phase “ice”.

Materials: 8 red gum drops, 4 yellow gum drops and 12 tooth picks per student, student science journal.

Procedures: *Each student must create 4 water molecules out of gum drops.

*The student must represent each phase of water using their models.

*The student will draw pictures of the molecules representing each phase of water in science journal.

*The model representing “ice” must use more room than liquid water, but less room than water vapor.

*The student must develop a hypothesis as to why ice floats in water.

Results: Water expands when it freezes. In ice, water molecules are actually further apart from each other. Hydrogen bonds easily form when water molecules have little heat energy and are moving slowly. The strong hydrogen bonds force water molecules into a lattice pattern, holding them apart from each other.

Investigating Properties of Water

Water molecules are naturally attracted to other water molecules as well as to molecules of other substances. The attraction of water molecules to other water molecules is called cohesion. The attraction of water molecules to other materials is called adhesion. These two properties are very important to a plant's ability to get water.

We can easily see water's attraction to itself by observing its surface. You can continue to add drops of water to a full glass of water until the water level exceeds the brim of the glass. The surface acts like a stretched elastic membrane or a skin. This property is known as surface tension.

This skin forms on the surface of water due to the force of the molecules in the liquid. Molecules in the middle of the liquid are attracted and pulled on equally by surrounding molecules. Molecules found on the surface of the liquid are pulled in a sideward and downward direction by the other molecules. The upward pull of the surface molecules is produced by air molecules. The air molecules have a much weaker attraction than the water molecules. The stronger pull by water molecules causes the surface molecules to be pulled downward and squeeze together, creating the tight skin that allows insects such as the water strider to walk on water. (8)

Asked students to observe droplets of water on different surfaces such as wax paper or cardboard. Students should have to diagram the different shapes and label them. Ask students how they think they could change the shapes of their water droplets.

Soap and other detergents weaken the surface tension of water. Soap molecules move between water molecules and weaken the cohesion of the water molecules from each other. Substances that reduce surface tension are known as surfactants. Surfactants increase the spreading and wetting properties of a liquid. Give students another opportunity to change the shape of a water droplet, but this time give each student small amounts of various detergent products. The students should observe and diagram the effect each detergent has on the shape and movement water droplets. Ask students to hypothesize what would happen to insects such as the water strider if detergents were added to their aquatic habitat. If the detergent weakens surface tension, could this insect continue to walk on the surface of the water? Challenge students to develop a classroom simulation to test their hypothesis. Allow students to observe insects at a local pond, or create a temporary classroom habitat for your students to observe.

Related Activity

To demonstrate how a surfactant such as soap can break the surface tension of water.

Materials: Two pieces of cardboard each cut into the shape of a boat, one soap chip,

one large tray of water.

Procedure: *In the rear of each boat cut a small triangular notch.

*Place a soap chip in the notch of one boat.

*Place both boats in the tray of water.

*Ask students to explain in writing what they think caused the boat with

the soap to move.

*Break the class up into teams of two students each. Allow each team to

experiment with different boat designs and placement of soap chips, and

soap chip size.(9)

Chemical Elements

Related Vocabulary

15. synthetic: produced by chemical processes rather than of natural origin.
16. molecule: a structure made up of two or more atoms.
17. atomic mass: unit used to measure the masses of subatomic particles; a proton has a mass of 1 amu
18. chemical bonding: combining of atoms of elements to form new substances.

Everything in the Universe, including plants, animals, humans, and minerals is made up of chemical elements. Scientists have discovered 92 naturally occurring elements and have found ways to produce about a dozen synthetic elements. Each of these elements has their own distinct properties. An element is a substance that contains only one kind of atom. Hydrogen contains only hydrogen atoms, oxygen contains only oxygen atoms. If we mix hydrogen and oxygen atoms in the correct proportion we can create a compound called water. When we link two or more atoms together we produce a molecule. The equation H2O represents one molecule of water.

During the mid 1800's a Russian chemist named Dmitri Mendeleev studied the physical and chemical properties of elements. As he investigated the elements, it became clear to him that some of the elements were similar to others. Mendeleev believed that there was an order or relationship among all the elements. He decided to develop a pattern or arrangement so that those with similar properties were grouped together. Mendeleev decided to arrange the elements in order of increasing atomic mass. His finished product produced an arrangement where properties of elements recurred at regular intervals. All the elements in a column showed similar physical and chemical properties. The elements to the left of the periodic table are metals. Those to the right are nonmetals. And the elements between the metals and nonmetals are called metalloids, which sometimes act like metals and sometimes act like nonmetals.(10)

After students have investigated the content area of “elements” they will view the video Fun with Science featuring Dr. Earl Danieley of Elon College. Students will need to be adequately prepared before viewing this film. Dr.Danieley speaks rather quickly and can be difficult for a learning disabled student to follow. The teacher should prepare a viewing guide to help the students focus on important points of the video. Dr. Danieley reviews important concepts in an entertaining manner, while emphasizing the importance of chemicals in our daily lives.

Chemical Reactions

A chemical reaction is a process in which the physical and chemical properties of the original substances change as new substances with different physical and chemical properties are formed. Chemical reactions are going on around us all the time. Some reactions involve just two substances, others many more. But whenever a reaction takes place, at least one substance is changed. The rusting of iron and baking of bread are just two examples of chemical reactions.

The substance that enters into the reaction is called the reactant. The substance that is produced by the chemical reaction is called the product. This process of reactants changing into products always involves a change in energy. Energy is always either released or absorbed during a chemical reaction. For example, heat energy is absorbed when sugar changes into caramel, and heat energy is released, when gasoline burns.

During a chemical reaction, atoms can form molecules, molecules can break apart to form atoms, or molecules can react with other molecules. New substances are produced as existing bonds are broken, atoms are rearranged, and new bonds are formed. (11)

Related Activity

To demonstrate that a new substance is formed during a chemical reaction.

Materials: The following materials will be needed for each team of two students.

One empty soda bottle, one-half teaspoon of baking soda, one-quarter cup of vinegar, and one large balloon. Procedures: *Place one-half teaspoon of baking soda in the empty soda bottle. *Add one-quarter cup of vinegar to the soda bottle. Quickly place a balloon on the neck of the bottle. *Carefully shake the bottle to mix the vinegar and the baking soda. *Set the bottle on the table and make observations. Observation: Students will answer the following questions after observing reaction. *Do you see bubbles when you add the vinegar? *Do the bubbles rise in the bottle? *How long does it take the bubbles to stop foaming? *What happened to the balloon when you put it on the bottle? *Does shaking the bottle cause more bubbles to form? *Does the balloon get larger when you shake the bottle? *After reading the above definition of a chemical reaction, summarize what you think happened during this demonstration.(12)

The Atom

Related Vocabulary

19. indivisible: cannot be divided any further.
20. compound: substance made up of molecules that contain more than one kind of atom; two or more elements chemically combined.

Teaching Strategy

It is important to explain to your students that the models they will see and build to represent abstract concepts are meant to be representations and should not be mistaken as " the real thing". Recent studies indicate that the majority of high school students may still be concrete operational learners. Concrete learners identify explicitly with models as "the real thing" and do not extend their ideas beyond them until the transition to abstract thinking.(13) The majority of the student's time should still be spent observing and experimenting how their own actions affect the chemical world around them. Time spent on such abstract concepts such as atomic structure will serve as information for answers to the questions commonly asked by my students. It should not be the main focus of the unit nor would I expect a student to memorize and be tested on it.

Having students compare their models to historical models can help the student see that even real scientists can begin with flawed ideas before they refine them to represent proven and accepted theory.

The concept that everything in the Universe was made up of tiny particles called atoms was debated for more than two thousand years. It was not until the 1800's when chemist John Dalton performed a series of experiments that the idea of the atom was finally accepted. The basic ideas of Dalton's atomic theory are as follows:

*All elements are composed of atoms. Atoms are indivisible and indestructible particles.
*Atoms of the same element are exactly alike.
*Atoms of different atoms are different.
*Compounds are formed by the joining of atoms of two or more elements.

This theory of matter became one of the foundations of modern chemistry.

Have students write Dalton's theory in their science journal. Show students visual representations of atoms, elements, and compounds. Explain to students that there are many different ways to represent atoms and compounds. Have students sort the pictures into three groups, single atoms, elements, and compounds.

Subatomic Particles

Related Vocabulary

21. nucleus: small, dense positively charged center of an atom.
22. proton: subatomic particle that has a positive charge and is found in the nucleus of an atom.
23. neutron: subatomic particle that has no electric charge that is found in the nucleus of an atom.
24. electron: negatively charged subatomic particle found in an area outside the nucleus of an atom.

Before you introduce the concept of subatomic particles, make a model of a lithium atom from wire, modeling clay, and string. You can find detailed instructions for this model in Janice VanCleave's book entitled MOLECULES. After you present the material on subatomic particles show the students the model of the lithium atom. Ask the students to identify the parts of the model. When using the model, make it very clear to your students, that this is not what a real atom looks like. Nor is this model showing the actual location of the electrons. This type of model, which is commonly referred to as "Bohr's Model", does represent the number electrons and energy levels a certain atom possesses.

As scientists continued to investigate and experiment they gained new knowledge that forced them to modify Dalton's theory. Niels Bohr, J.J. Thomson and Ernest Rutherford were all scientists who contributed to the wealth of Knowledge we now have regarding subatomic particles. The three main subatomic particles are the proton, the nucleus, and the electron. They are called subatomic because they are smaller than an atom.

The nucleus is the "core" of the atom. It makes up 99.9% of the atom's mass. And at the same time it is the smallest part of the atom. The nucleus is one hundred thousand times smaller than the entire atom. It is in the nucleus where the protons and neutrons are located. While the electrons can be found orbiting around the nucleus.

Protons are positively charged particles found in the nucleus of every atom. All protons are identical regardless of the element in which they found. Neutrons like protons are found in the nucleus and are also identical to all other neutrons regardless of the element in which they are found. Neutrons have no charge.

Electrons are very small particles that whirl around the nucleus of the atom. Electrons have a negative charge. If the atom is neutral, meaning it has no charge, the number of negatively charged electrons is equal to the number of positively charged protons. Electrons seem to be locked into a certain area around the nucleus depending upon how much energy the electron has. Electrons with low energy are found closest to the nucleus. Electrons with more energy are found farther away from the nucleus. Each energy level has a maximum number of electrons it can hold. The first level will fill up first and will hold up to two electrons. The second and third will hold up to eight electrons each. It is the arrangement of the electrons which gives an element its chemical properties. (14)

After students have been introduced to the structure of the atom, they will be required to make an atomic model of one of the elements using wire, clay and string. Put the name of the first sixteen elements each on a separate piece of paper. Place all the pieces of paper into a large beaker. Students will pick the name of the element that they must represent. Depending on the available space in the classroom, you may chose to have students make models of all the elements of the periodic table. As each students finishes their model, they must write an explanation of why they depicted their element as they did. Ask the student to answer questions such as “Why do you have five protons in the nucleus?” After the teacher has met with each student to discuss their model and reviewed the written explanation, the student may start to research their element. After the student has finished a written report on their element, they must create a riddle about their element that can be answered by reading their report. The teacher will type all the riddles and display reports around the room. The students will have to answer all the riddles by reading their classmates reports. Students who have difficulty reading can be paired with a strong reader. Companies are starting to put out high interest talking science software. Students with severe writing disabilities can use voice activated word processing programs.

Notes

1. Information obtained from a Richard Lavoie lecture on “Learning Disabilities” CLCD conference 1994

2. This activity was adapted from content contained in J. Stepans and Lois Veath’s article How Do Students Really Explain Changes in Matter? (Science Scope, May 1994)

3. Content information obtained from Cooper, Christopher, Matter, pages 8-11.

4. Activity from Ardley, Neil, The Science Book Of Water.

5. Content information adapted from Maton, Anthea, Matter: Building Block Of The Universe, chapter 2.

6. Activity suggested by seminar leader Professor Michael McBride.

7. Activity from Ardley, Neil, The Science Book Of Water.

8. Content information adapted from Roa, Michael, Environmental Science Activities Kit.

9. Activity from Council of Environmental Education, Project WET.

10. Content information adapted from Maton, Anthea, Matter: Building Block of The Universe, chapter 5.

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12. Activity from Mebane, Robert, and Rybolt, Thomas, Adventures with Atoms and Molecules.

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