Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1980 Volume V: Man and the Environment

Matter

Curriculum Unit 80.05.08
by Zelda L. Kravitz

The purpose of this unit is to show that by using the Law of conservation of matter, the student learns that matter is not created or destroyed, but merely transformed. The understanding of this law can be better explained through the use of measurements in experiments. The knowledge of the writing of simple word equations, and chemical equations are necessary skills. Laboratory techniques must be developed in the young student, and also refined. To understand reactions, the structure of matter is discussed; to show the complicated structure of matter is essential for the clearer understanding of actions and reactions. This knowledge aids in understanding how drugs, prescription and non prescription, have to be carefully used, if at all. How the mere act of smoking tobacco results in carbon exhaled, for example. This can lead to a study of pharmacology and how the knowledge affects the individual. Illnesses which depend on chemicals for control can be introduced for study: insulin and its relationship to diabetes, lithium maintenance to block the receptor site from receiving too much dopamine and resulting in, for example, hallucinations. L-Dopa, to reduce tremors in Parkinsons disease, are all chemicals causing metabolic changes which may affect individuals.

The effect of Marijuana, cocaine, L.S.D. and others on thought processes can be stated as action and reaction data. Even the effect of psychopharmacologists, and neuropharmacologists working on experimental drugs to boost mental sharpness, can be better understood when one learns more of chemical brain carriers. Urine testing is also a good way to determine the results of body metabolism.

The study of matter leads to a better understanding of the unique chemical nature of our lives; even to the care that we must take in handling of plants, or even leaves of plants that we admire, or eat parts of.

MATTER

(Outline)

I. Law of Conservation of Matter

A. Statement of Law
B. Techniques of measurement

    1. Mass
    2. Volume
C. Structure of Matter
    1. Atoms
    2. Leptons
    3. Quarks
D. Action and Reaction
    1. Word equation
    2. Chemical equation
E. Pharmacology
    1. History
    2. Prescription drugs
    3. Non-prescription drugs
    4. Hazards
        a) Narcotics, non-prescription drugs
        b) Plants
    5. Chemical aids to illness
        a) Mental health
        b) Physical health
F. Conclusion: Study of matter leads to better understanding of chemical nature of life.

NARRATIVE

Introduction

The information here enclosed is suggested as and introductory course in Freshman Science for those students who have been selected because of low mathematical ability to adapt to a laboratory oriented course serving as an introduction to Biology, Physics, and Chemistry, which will also serve as a basis for other science courses. The teacher has no choice in the selection of his or her students, or to pre-test in order to group them. Students who have taken Algebra in grade 8 (eight) are automatically steered to Biology as a freshman course with the idea that they only are college material and will take Physics or Chemistry which makes them eligible for college credits, to which Physical Science is not accorded the honor.

Since the skills of the students approaching this course are unknown; they arrive with their concept of a laboratory as “Is this where we have explosions?” “Aw, come on and do some experiments for us and blow up this place!”

Of course neither of these statements are followed through or planned for.

The purpose of this unit is to help the student to:

1. Develop his skill in observing, obtaining, recording, analyzing problems dealing with matter.
2. Handle equipment which either he has constructed or assembled.
3. Learn scientific mathematical skills needed for an introduction to science.
4. Understand his environment and his relation to it.
5. Learn how chemicals, naturally found, and laboratory produced affect his behavior, and well-being.

Since the laboratory contains equipment graduated in the SI units (system international); and since the international metric system is a certainty for use eventually in the United States, we have to develop the concept of the Metric System and its basis of units of ten. To make the Metric System less difficult labs can be organized very quickly when the child is taught that meter designated by measures distance, liter symbolized by 1 measures volume, and mass is measured in grams symbolized by g.

To give the concept of units of ten (10) the abacus can be displayed showing each of the 10 balls comprising one line, and ten balls equal one line. thus each ball is 0.1 of a line. A simple way for a child to remember metric units is to show him that this unit is based on tens and moving the decimal point to the right or left increases or decreases by units of tens. Usually it is not necessary to go beyond the units of 0.001 or 1,000, so the student learns only three terms; meter, liter, and grams. Then the prefix with the decimal values which are the same are attached, and we are ready to move into an experiment, centi equaling 0.01, milli equaling 0.001 and kilo equaling 1,000. We can also introduce the thermometer at this point since the Celsius thermometer is based on units of one-hundred.

Before actually doing the measurements, laboratory equipment, baby bottles, soda bottles, small wrenches, advertisements of 98 mm watches can be shown, mobiles from cereal boxes, and labels can be constructed. It is also helpful to teach that the thickness of the fingernail is approximately one mm and the width of the little finger is one cm.

We have given the student the basic tools and now we proceed with our experiment. We have to set the form at first as a guideline, and as the year proceeds the student learns to set up his own problem. To suddenly thrust this onto him will frighten him.

Although we have the measuring tool, we also have at this time to develop the idea of what we are measuring. The general concept of matter that has mass.

We begin with the students body and handy materials: cigarettes, weighing of a hair, fingernail, paper clip, pencil, sheet of paper, etc. See Experiments I III.

If equipment is limited, the teacher can ditto a metric ruler for perhaps 20 cm, and the child can be given a copy to paste in his book. For the construction of a simple balance using a can cover, string, and a small piece of wood can be constructed. A paper clip (medium size) has been found to be an acceptable gram weight.

Knowing that matter occupies space and has mass, in the introductory experiments, we now need to learn something about the structure of this matter. However, to stimulate the child's interest in matter's structure, how matter acts and reacts, and why it does so, calls for a series of simple experiments first; and then we can develop the interest for and why things happen.

Purposely the three forms of matter have been omitted as a separate series, because more than anything else, liquid, solid, and gas are previously taught, and can be added incidentally. Plasma as a form of matter is not necessary in our discussion here, at this point.

Our world is made up of many things. Some are large like mountains, some are small like grains of sand on the beach, and others are like us. Our study of matter will help to explain how things are made up. The simplest kind of matter is the element and is made up of one substance, however, the elements are of two types. Some are natural and some are made artificially lasting fractions of seconds. Ninety-two are natural and 14 are manufactured or synthesized. This information is a long step from the days of Democritus in the fifth century who thought there were only four elementary substances: stone, air, fire and water. The smallest particle of the element is the atom, and everything in the world is made up of these atoms or combinations of atoms called compounds. Each element has been named and scientists have devised a shorthand method, acceptable throughout the world.

The atom has two main parts, the nucleus in the center and the electrons which circle in layers or tracks outside the nucleus. Inside the nucleus are two main substances called protons which have a positive electric charge; and neutrons which have no charge and are neutral. The proton is 2,000 times heavier than the mass of the electron. There are other particles in the atom. Atoms are very small. A quarter billion of them would measure only about 25.4 mm in length, however, most of the atom is empty space. Mesons are like a nuclear glue which holds protons and neutrons together. The mass of the meson is between that of the protons and electrons. There are two kinds of mesons called m, or pions. The lighter ones are called muons u and there are also neutral pions m'. Pions live 10-1 8 seconds, mesons live 10-6 seconds. Bohr said the electrons travel in the orbits but when they jump from one orbit or path to another they give off radiant energy. Recently in 1974 when there was a high energy collision of matter, particles called leptons and hadrons were discovered. The hadrons are complex, and evidence seems to show they have not only an internal structure, but 100 kinds have been identified; and some of the hadron, that is the simpler part, is called a quark. There was another particle discovered called the lepton. There are four known leptons which include the electron and muons above mentioned and two kinds of neutrinos. The muon is about two-hundred times heavier than an electron. There is belief that quarks are so entangled inside the hadron that they can never be separated. Hadrons decay very rapidly and their lifetime is 10-2 ^{3} seconds; but they are a distinct type of matter.

An even newer particle called the Psi was discovered and led to the discoverers Samuel C. Ting and Burton Richter sharing the Nobel prize. The Psi particle has a lifetime of 10-20 seconds or 1,000 times that of the hadron even though it has the same mass. There is something yet undiscovered in the Psi which slows its decay. These recent discovered particles are the result of electrons and positrons being made to collide at high energy, and then the particles are sorted out from the remains of the collisions. The collisions take place in a piece of equipment called a Spear in which electrons and positrons circulate in opposite directions at nearly the speed of light while 10” electrons circle clockwise. Interestingly the electrons for this experiment are boiled off a hot filament as in a vacuum tube. Thus we see the scientists are constantly searching and finding new particles of matter.

All matter possesses chemical properties which determines how the matter acts. How matter combines with other matter will be our concern. As the electrons revolve in their orbits around the nucleus, the distance of the electrons from the nucleus and the number of electrons in the outer orbit will determine how the matter acts. The atom as the basic unit of matter can combine with another atom provided that the required number of electrons in each atom’s outer orbit doesn’t exceed the number of electrons based on the required amount.

Although the model of the atom has remained fairly stable over the years, a newer theory has shown that because of the high speed of the electrons an electron cloud is possible, similar to that of a whirling fan when you couldn’t see the separate blades, but only blurred ones.

When an atom gains one or more electrons or when it loses one or more electrons it becomes an ion and has an electrical charge. This gaining and losing of electrons results in the formation of compounds as a result of bonding together. The gaining and losing of the electrons does not destroy matter, but merely changes the appearance of the matter. The matter doesn’t go anywhere, it just shifts around. This is called the Law of Conservation of Matter. By following this law we can better understand what happens to substances when they combine whether by the use of heat, or chemical action, or even enzyme action within our bodies. Since everything is made of something, and since these somethings can combine or bond, this can also help to explain how matter is formed; and many combinations are possible. How electrons bond causes chemical reactions, and is changing the world.

When battery acid is dropped on clothing the remaining substance is black carbon. When sulfur fumes are released from car pollution they combine with oxygen in the air to form noxious fumes; and when these fumes combine with moisture in the air, buildings crumble slowly; statues lose some of their smooth surfaces. When proper food is taken into the body the chemicals in the mouth start the food on its trip through the body to become the necessary protein, by the action of chemicals.

By understanding the interaction of matter, we learn how nerve cells secreting hormones can influence the activity of brain cells for example. We learn how medications which are chemicals can influence thought and action; and how the lack of chemicals can cause alcoholism and mental breakdowns, or even blindness for example.

Since nerve cells communicate by releasing neurotransmitter chemicals at synaptic junctions, anything that interferes with binding of the neurotransmitter can disturb or change communication and disturb behavior. If a drug can be introduced that is the same as what is lacking, it can make it possible for the message to reach the cell, then the behavior can be normalized. For example, it was thought that Parkinson's disease or shaking palsy was the result of degeneration of neurons near the center of the brain. It was found that the normal amount of dopamine needed was not naturally there, and the brain was depleted, so the tremor, rigidity, and movement delay resulted. With the addition of L.-DOPA given by mouth, the L.-DOPA stimulates the receptors in the brain and the patient is able to walk better. In certain mental illnesses such as Schizophrenia, there seems to be an excess of dopamine from the nerve endings causing an over activity in the person. Here a medication is given that blocks the excessive amount of dopamine, prevents over stimulation, and diminishes the symptoms of schizophrenia which is one of the most common mental illnesses; with such a scope of afflicted individuals, that the World Health Organization has launched an extensive research program to try to eradicate the illness due to the biochemical nature of the many dopamine receptors in the basal ganglia of the brain.

There also was a finding of an enzyme adenylate cyclase of the basal ganglia of the brain. With this finding there is a new method of screening of drugs as dopamine agonists (agents) against Parkinson's disease or antagonists (agents against schizophrenia). With this information just about eight years old it is possible to evaluate illnesses by the presence of the dopamine and prescribe medication earlier.

Research has also shown that the role of the enzyme cyclase was not limited to the nervous system of vertebrates but also that the enzyme serotonin could affect insects and that drugs could affect neurotransmitter receptors. Insecticides such as Parathion and Malthion were developed.

Drugs affecting neurotransmitter receptors frequently produced changes that occurred in patients with neutral or neurological diseases. As a result miners who were exposed tomanganese poisoning when given antischizophrenic drugs show Parkinson symptoms. An interesting factor has been that L.S.D. can produce hallucinations similar to those of schizophrenics. These abnormal conditions may be genetic through mutation, or acquired through exposure to such toxins as manganese.

Many neurobiologists have shown that nerve cells respond to stimulation at the synopses, of one or more ions. This may change the ability of ions to flow across membranes, thereby changing the person's voltage at that point. The neuron acts by absorbing the hundreds of chemical messages; and deciding when to react; research led to an understanding of such actions as to how glycogen (sugar) was broken down, protein metabolism, muscle contractions, pupilary dilation, intestinal peristalsis, and action of hormones and drugs that affect behavior. From this information, a better understanding of the brain, neurotransmitters, and the effect on genetic material that may in the end lead to changes of behavior, such as memory has been obtained.

Szent-Gyorgi has said, "If we want to find out something about the world around us we have to ask questions modestly, that is, do experiments." With the above in mind, I have suggested the list of experiments to be done by students in order that they may understand the actions and reactions of matter so that they can better understand that which surrounds them; that what is taken into their body reacts and changes and that matter is not destroyed but merely changed around.

In the study of actions and reactions it is important for the student to realize that whatever is taken into the mouth may be affected by chemicals within his body, and for that reason a brief introduction to pharmacology is necessary as it has developed over the years; and is as old as man himself.

Early man looked for spirits to combat sickness. Alcohol was used to ease pain. Today we know it as an anesthetic. The bark of cinchona was the source of quinine to treat malaria. Curare was developed as a fatal poison. Thus, we had the beginning of pharmacology, drug actions and reactions, and chemical-biological reactions.

It is important to understand how chemical agents affect living processes, whether as the results of prescription or non-prescription drugs, living organisms, or plants, many of which are in the backyard or even the house. The most ancient records were found from 1600 B.C.E. in Egypt where 700 remedies were listed, and a person was able to choose which doctor he wanted. Babylonians lived in a world of demons, but doctors were separated from clergymen, and fees were set by law. In Greece and India the temple was the most common place of treatment, and in 500 B.C.E. a professor in India grafted skin from one person to another. In the sixth century B.C.E. smallpox vaccination was known, but did not reach Europe for 2,000 years. Hippocrates in 440 377 B.C.E. taught that disease came from natural causes, and that the body can recuperate with the help of fresh air, good food, purgatives, enemas, and blood letting. Galen originated such things as tincture of opium and vegetable drugs, and so influenced medicine for 1500 years. During the middle ages the Crusaders brought back medicinal information, and used their texts as late as the seventeenth century, for compiling hundreds of drugs. The Arab world developed accurate record keeping; Moslems established apothecary (drug) stores, and set state inspections, early consumer protection. After the thirteenth century pharmacies developed in Europe and the search for the "elixer of life" was developed. Florence, Italy issued the first book in the fifteenth century. Paracelsos believed the body was composed of chemicals in early sixteenth century; and he used tincture of opium, and mercury to treat syphilis. He said all drugs were poison, but the dosage changes it.

In 1628 Harvey gave drugs in the vein, and said they were better than by mouth. John Wepfer in the early seventeenth century performed experiments on animals. In 1776 a pharmacist's apprentice stated a relationship between the amount of drug given and the biological response. In 1806 Frederick Serutrner isolated a pure vegetable drug and the synthetic manufacture of drugs began. Their reactions on the body was studied. Curare, which paralyzed the muscles, had to be studied to find what part of the body was affected by drugs. In the late nineteenth century the physiochemical reactions in cells with drugs, was studied. In 1841 James Blake stated that the chemical structure of drugs determines their effect on the body. In 1923 Ehrlich showed that drugs interact with biological material to produce certain effects. In 1842 it was found out that the effect of drugs can be changed or stopped by chemical conversion in one's body. Pharmacology is now the study of reactions in a living organism by chemicals, except foods. About 1908 a Department of Pharmacology was expanded at the University of Michigan. In 1921 insulin led to the successful diabetes treatment. Chemistry supplies pure compounds,; physiology supplies experimental techniques all necessary for determining the biological effects of pure chemicals.

As we see, the development of pharmacology is one of using pure compounds. We can't forget the danger in our home and outdoors, especially from plants. There are many poisonous plants, to eat and touch. Twelve thousand people have been poisoned in one year, especially children under five years of age, who pop anything into their mouths. People try to make "tea" out of weeds and unknown plants. Poison ivy as an irritant is the best known in this country. The toxin inside the leaf can cause a skin rash. Poison oak and sumac, the leaves and vines tomatoes and potatoes contain poisons called alkaloids. Cherry twigs contain cyanide. Seed kernels from peaches and apricots contain cyanide; “a cup of apple seeds may kill a person.” Green leaves of rhubarb contain oxalic acid poisonous, damaging human kidneys. Leaves of tomatoes, potato, and eggplant are so poisonous that handling may be fatal, causing rapid heartbeat and nervous system disorders. Jimpson weed grows in backyards; fox glove is a source of digitoxin affecting heart muscles; digitalis is made from fox glove and, as a medicine, makes heart muscles contract to pump more blood. Wisteria can poison children. Buttercup sap irritates the mouth. Lily of the Valley makes a poison like digitoxin and acts similarly. Even dandelion leaves can be poisonous, when eaten.

Matter is seen everywhere. Matter interacts for good or bad. Matter cannot be created or destroyed, but eating some matter may destroy you. Be Careful!

Many different experiments are included to aid the teacher in having enough of a variety to reach various ability students or to reinforce or review concepts already learned.

Many educators and philosophers worry about what children can’t do, we instead are concerned with all the things they can do; and reinforce those skills in which they are weak.

If at first children are afraid to work alone, groups of three or four can be started; and as confidence is gained and equipment becomes more available, individual experiments are most beneficial.

All children should write their own reports, and keep them, after correction, in a notebook. Experiments should be marked differently than regular work. For example, if anything is missing a “0” denotes this and the work is corrected and returned for recorrection.

CLASSROOM ACTIVITY MATERIALS

Chapple, Joe Mitchell, “ *Heart Songs* ”, Joe Mitchell Chapple, Inc., Boston, 1937, p. 140. “O Dear What Can the Matter Be?”, a lilting early American Ballad, to introduce the unit.
Introduction to Chemistry , series of four tapes and film strips, very good for students.
Showaiter, v., Education research council, 1971, *Man and Molecules* , series of 15 minute tapes and the exploring of scientific accomplishments in: space, environment, mind, aging, discovery of elements, molecules, etc.
Newton, David, *Activities for Exploring Careers in Science* , J. Weston Welch, Portland, Maine, 1976.
Trip to Yale Medical School Historical Museum for exhibit of ancient measuring materials, and including the Streeter collection of weighing and measuring devices in medicine and pharmacy.

I made slides and photographs of some of the materials in the above display cases. They have not been developed yet. (Great courtesy extended by the reference librarians.)

INTRODUCTION TO UNIT (CHIEFLY FOR TEACHER)— LESSON PLAN

I. Teacher places the word MATTER on board (large letters).
II. Tape recorder in background plays “0 Dear What Can the Matter Be?”
III. Teacher canvasses the class to see if the relationship between the word and the tune can be established.
IV. Teacher blows up balloon, lets it move in room.
V. Teacher drops in rapid succession: ball, potato, pen.
VI. Class is told to record what connection there is between what is happening in class and word and song.
VII. Teacher chews cracker and places litmus strip in mouth. Class notes color change, if paying attention.
VIII. Teacher lets out hints about properties of the substances she is using, and guides students to song relationship. Teacher uses such phrases as: everything is made up of ....

Everything takes up .... and has ....

(space) (mass)

Everything is made up of ....

(matter)

IX. Teacher lists Matter, Mass, Volume on board.
1. Teacher asks pupils to list things which would fit under each of the words.
2. Pupils given assignment to list the three words on board, and then go home and list three examples for each word.
X.. Next day Laboratory work on properties of matter.

INTRODUCTION TO PHYSICAL SCIENCE LABORATORY— LESSON PLAN

The purpose of your first series of experiments is to introduce you to methods to be used in the laboratory, learn how to work safely in the laboratory, learn the proper skills, and how to handle materials in the laboratory.

We try to be very neat. Don't spill. Return spoons, stoppers, *only* to bottles they belong to. *Don't* mix chemicals, or solutions unless so directed. Things spilled should be wiped up.

Safety and *caution* are the keywords.

To prepare for an experiment:

1. Always read directions until you understand them. Do your homework to prepare for an experiment.
2. *Never* start an experiment until you are sure what to do.
3. Ask for assistance if in doubt.
4. Liquid wastes go into the sink.
5. Solid wastes go into separate containers.
6. Returned equipment or used equipment must be left *clean* .
    a. clean test tubes are put on draining rack.
7. DON'T TASTE ANYTHING UNLESS TOLD. SOME SUBSTANCES MAY BE HARMFUL.
8. IF ACIDS ARE USED AND SPILLED *RINSE* immediately, call instructor AND NEUTRALIZE (MAKE WEAKER) WITH A BASE.
9. Acid on body, rinse with water, wash with soap, CALL instructor.
10. Alkali on body rinse with water, wash usually with vinegar, CALL instructor.

If substances fall on desk, always leave clean or neutralized.

Sloppy handling of materials may result in expulsion from the laboratory.

Supplies and equipment cost money. Careless use can cause you to lose credit for your work, and pay for broken equipment.

PRE-TEST-LESSON PLAN

I. Place answer to left of number.

___ . 1. Add water to acid or acid to water.
___ . 2. Metric units are based on ___ units.
___ . 3. 0.1 is a ___ .
___ . 4. Gram is a measure of ___ .
___ . 5. Liter " " " " ___ .
___ . 6. A graduate is used in the laboratory to ___ .
___ . 7. A meter stick is used to measure ___ .
___ . 8. Mass is a measure of ___ .
___ . 9. Meniscus measures ___ .
___ . 10. Density is a measure of ___ .

II. Solve the following problems: Do all work on paper.

(1)	(2)	(3)	(4)	(5)
38.47	3.89	4.8)5.989	24.98)3.6956	38.79
1.49	0.49			x 1.4
+138.40	+1.9			
1. ___.	2. ___ .	3. ___ .	4. ___ .	5. ___ .
	(6)	(7)		
	989.4	4.589		
	x1.34	-1.234		
	6. ___ .	7. ___ .		

I. Purpose: To determine the problem (the reason for doing the experiment).

___ 8) Draw a 2 centimeter line.
___ 9) Divide the 2 cm. into 20 millimeters-
___ 10) Where is 40 ml. on the container.

(figure available in print form)

Choose the best answer

___ 11) Decibels measure sound light heat.
___ 12) Light is measured in angstrom, density, velocity.
___ 13) From the graph answer the following questions:

(figure available in print form)

___ 13) In 8 minutes the temp.
is 3’, 30’c, 3’c.
___ 14)
___ 15) Centigrade is the metric temperature scale.
___ 16) Heat and temperature can be measured the same way yes, no, maybe.

II. Materials: test tube rack

test tube(s)

litmus paper; 5 red, 5 blue

Caution : Keep fingers, table, and paper strips dry until you wet them with the powder or liquid.

III. Procedure:

1) Place *20* drops of each liquid and/or each powder in each test tube. Return eye dropper to jar taken from. DON’T MIX THEM UP. OTHERS WILL SUFFER AND YOU WILL LOSE CREDIT!!!
2) Add 1 strip of each color litmus paper to each tube. What happened?
3) Rinse tube thoroughly.
4) Add 1 tsp. powder (white) to each tube.
5) Add *10* drops of each liquid.
6) What happened: Describe, color, odor.
7) Add litmus strips: one strip each. Was there any change: color, odor?

8) Record information in chart below:

	Red Litmus	Blue Litmus	With White Powder
Tube 1			
Tube 2			
Tube 3			
Tube 4			
Tube 5			

IV. What do you think the reason was for doing the experiment?

A. State the Problem.:

V. What facts did you learn from this experiment that is you *conclusion* . List them briefly, but accurately. The conclusion should answer the problem.

EXPERIMENTS

The experiments listed below are to be used to aid the students in understanding the concept that matter having mass and volume can neither be created or destroyed, but changed in form. Laboratory reports are essential for each experiment. Descriptions of the materials before and after the experiment should be utilized. All senses should be used except tasting, unless precautions are released.

1. Burn a candle. Light it and be sure that it is on a piece of metal, as a can cover. Throw match in a metal can or beaker filled with water.
2. Let an ice cube melt at room temperature on paper towel (precautions removed).
3. Place a snail on a towel. Bring a lighted natch near, but *NEVER* touching the snail.
4. Burn a cube of sugar (precautions removed).
5. Burn a piece of bread (precautions removed).

6. Burn a wooden splint (take precautions).

Determining Mass

All items are to be weighed before and after the experiment.

1. Blow up a balloon, weighing it before and after blowing up to the largest size without breaking.
2. Measure Fe filings. Weigh them, and put them aside until the entire is covered with rust. To hasten this process, a measured amount of water may be added. Leave for a few days.
3. Fill an empty medicine bottle (plastic-small) bottle one-third full of water. Add one-fourth of one-third water. Add one-fourth tablet of alkaseltzer, and immediately seal the bottle. (Remember that one cubic centimeter or one ml. or water weighs one gram.) (We will neglect the room temperature at this time.)
    a. Using a word equation explain the source of the gas.
    b. What was destroyed? Was anything destroyed?
    c. Use a chemical equation to explain the gas source.
    d. Using limewater, test the gas. You may have to do the experiment again without weighing everything. Blow gently into the straw.
    e. How can you explain the result?
    f. Write an equation, word or chemical, showing what happened.
    g. Label all answers.

Unmeasured Masses but Chemical Changes

1. Have a smoker take several puffs of a cigarette, and blow smoke through several sheets of facial tissue.
    a. The teacher should in advance call the Southern Connecticut Lung Association and borrow their equipment for CO gas detection, and the other apparatus, to measure before and after smoking.
2. Breathe through a straw into limewater, and report the changes.

3. Using litmus paper, phenothalein, pH paper, separately test: saliva, toothpaste, milk of magnesia, vinegar, baking soda solution, and mouthwash. Record data in a chart you set up yourself.

a. Rinse mouth with mouthwash and test mouth with indicators again separately.

b. Is there any change?

4. Place Iodine solution on a cracker. Chew cracker, and spit into the plastic receptacle. Test with iodine again.

a. Repeat the chewing of the cracker again, etc. and this time test the substance with Benedicts and Fehling solutions, separately.

5. Combine baking soda and vinegar. Use 10 grams of baking soda. How many drops of vinegar will cause something to happen?

What is here but we can't see it?

1. Using solutions such as NaCl, KCl, Li2Co3, or any other, place a wire loop in the solution and then in the hot part of the bunsen burner flame. Record results in a chart.

2. Insert the tip of a strip of strip filter paper into black (India Ink), be sure that is is real India Ink. Don't let the filter paper touch the sides of the container. Use either a 1,000 ml. tube, or a quart size milk carton. Try doing the same thing with tomato juice, red ink, cocoa mixture and black paint. Leave this overnight, and cover the top.

3. Take a stained piece of cloth. Add bleach to one piece, and peroxide to another. Did anything happen?

Can we time what we do?

Does Temperature Affect the Volume of Matter?

Sometimes we want to find out what happens to matter over a period of time. We need to record the information of a graph. This can be shown by heating a test tube one-half full of anti-freeze, and one test tube of the same amount of water. Inserted in each tube is a Celsius thermometer. Both are heated by bunsen burners. Children doing this experiment should work in groups with each one furnishing a separate report; the information is best collected in a chart, and then transferred to a graph. What happened to the volume of the liquid?

I've found that the concept of comparing two or more substances over a period of time can be introduced by using a metronome, which pivots on a shaft, and can be adjusted to various speeds; and comparing it to the movement of a clock; thereby giving the student the concept of a graph being able to compare two or more substances. The student then can be shown how to collect data, place it on a chart and from the chart onto a graph, which he makes himself. Early fall is a good time to do this experiment, as people are starting to think about winterizing their cars.

A homework assignment might be for the child to go home, look in the toilet tank, and try to find out the function of the ball cock in the toilet tank; and also in the interest of conservation, a brick placed in the toilet tank will conserve water. The fact that matter has volume needs to be stressed here.

Doing an experiment at home?

Children at home can be directed to have a box of baking soda near the range or oven. Then they can be asked to figure out why baking soda can be used to put out a flame. The teacher should demonstrate this, as it may be a bit of a mess if all children try it in the class first.

LAB SHEET REVIEW

---

1. What is matter?
2. How do we measure matter?
3. What units do we use to measure matter?
4. How did you measure matter to find out how much mass it had? What are units measured in?
5. How did you find out how much space a substance occupied? What is that space called?
6. Below is a puzzle. Find as many words related to what we have been studying. List the words. Words are shown in all directions.

(figure available in print form)

Units of Measurement

In this course we many times measure the materials we use. Therefore we use the metric system, the *internationally* accepted units of measurement, chiefly in our classes.

The metric system is very easy. All you have to remember is that it is based on units of ten (10), and when you use these units, they can be used to measure how much space (volume), mass and distance.

1. grams-measures mass (how closely particles are packed)

2. liters-volume

3. meters-distance

You will make your own meter ruler, or you can buy one. (See next sheet for details.)

To show you how good the metric system is, do the following and complete the chart:.

1. Measure the thickness of your hair in metric units.

	Metric
1 hair (thickness)	
1 fingernail	
thickness of your eyeglasses	
regular & king size cigarettes	
thickness of a sheet of paper	
your height	
distance between your eyes	
distance from outer edge to center of eyeglasses	
length of thumb	
thickness of paper clip	
length of the room	
thickness of the door	

What is the problem in this experiment?

What is your conclusion?

Purpose:
To Determine the Problem.

This experiment may take 2 periods.

Procedure:

I. Take snail from Pail.

II. Place snail on desk.
III. What happens after every 5 minutes (for 20 minutes record what you see.)
IV. After 20 minutes touch snail with pencil.
    A. What happened?
V. Place lighted match near to snail but not *on it* . Describe what happened.
(VI. Use format of ice-cube!)

IIIA.

How does the snail differ from the candle.

The candle gives off ___ and ___ *.*

The candle moves when ___ .

The snail ___ when touched.

The snail ___ even when not ___ .

The snail ___ when touched with a pencil.

The candle ___ when touched with a pencil.

The problem this experiment tries to explain is:

How does your conclusion explain the problem: Or how do the results of the experiment explain the problem?

Review

New words learned to date. Know their meanings, and how to use them.

1) observant	6) laboratory	11) blue litmus
2) problem	7) safety	12) color
3) materials	8) science	13) odor
4) observation	9) litmus paper	14) procedure
5) conclusion	10) red litmus	15) caution

Problem:

To find out what happens when you breathe into a clear liquid.

STUDENT BIBLIOGRAPHY

Alcohol Council of New Haven, *Chemical Use/Abuse and the Female Reproductive System* , DIN #211, Phoenix Arizona. An excellent pamphlet for teacher and students.

Axelrod, Julius. “Listening to “Listening to Nerves Talk,” *Science Quest* , Vol. 52 #7, Sept., 1979, p. 18. Very well told story of how nerves transfer impulses; story told by Nobel Prize winner.

Gallant, Ray. *Explorers of the Atom* , Doubleday, 1977. Historical data well illustrated.

Gamow, George. *The Atom and its Nucleus* . N.J., 1961. A good book for structure, well illustrated.

Goodrich, Warren. *Learning About Science through Games* . Stackpole Books, 1964. Delightfully illustrated.

Hardin, J., & Arena, J. *Human Poisoning from Native Cultivated Plants* . Duke University Press, 1974. An excellent sourcebook.

Krockmal, Arnold & Connie. *Guide to Medicinal Plants of* U.S.. Quandrangle, N.Y., 1973. Excellent source for adults, pictures.

Feinberg, G. *What is the World Made Of* ? Doubleday, 1977. Atoms, Nuclei, particles, quarks fully discussed.

Milgrim, H. *Exploration in Science* . E.P. Dutton, N.Y., 1967. Basic experiments, child could also use.

Meyer, Roger & Miriam. “The Heroin Stimulus,” *Review of the Sciences* ,

May/June, 1980, p. 23. Certain drug block heroin. (New Haven

Register on Saturday, July 26, 1980 reported this used in heroin local drug overdoses.)

Mullen, Virginia L. *Chemistry Experiments for Children* , Dover Pub. Inc., N.Y., 1968, pp. 85-94. Kitchen chemistry of everyday things, well illustrated, easy for students.

New Sciences , New York Academy May/June, 1980, p. 29. “Artificial sweetners may be hazardous for heavy smokers.”

Romer, Alfred. *The Restless Atom* , Anchor Books, Doubleday, 1960. Up to date of publishing, historical contributions of famous scientists, based on their experiments.

Shapiro, Gilbert. *Physics Without Math* . Prentice-Hall, 1979, p. 344. Excellent reading list, useful.

Shell Oil Co. *Chemical Do’s and Don’ts Book* , 1979. Practical for home distribution, discussion of safe use and storage of many household products.

Science from Toys . (no author) Macdonald Educational Co., 1972. Idea of teachers banding to make science equipment.

Townsend. *Energy Matter and Change* . Scott Foresman, 1973. A text very well illustrated pictures very interesting, p. xiv: excellent metric puzzle for students.

Unesco, 700 Experiments for Everyone . Doubleday, 1962. Very good directions and diagrams for the constructing of simple equipment.

TEACHER BIBLIOGRAPHY

Amaldi, Ginestra. *The Nature of Matter* . University of Chicago, 1966. Good background material.

A.A.E.A. Pharmacy. *Guide to Generic Medicines* . Modern Maturity, June-July, 1978, p. 39. Lists of medicines.

Armstrong, J.A., Slaughter, G.S. Marks, & Armstrong, P.W., *Canadian Journal Physiol, Pharmacology* , May 1980, 58: 459-462. There is a rapid disappearance of nitroglycerine following incubation with human blood, and belief is that the metabolism occurs in other organs in addition to the liver, perhaps even in the red cells.

Barbuto, Joan, “Women to get Help on Math.” New Haven Register, Feb. 24, 1980.

Barnes, Porter, “Effects of Aging on the Distribution of Lutenizing Hormone.” *Endocrinology* , June 1980, 0013-7227, p. 1980

Halden. “Behavioral Medicine, an Emergent Field,” *Science* , July 25, 1980, p. 479. This field attempts to locate neurochemical mechanisms by which such states as emotional stress leads to disease. There is a chemical indicator of maternal deprivation which stunts physical and emotional development of babies. (ODC) Interesting.

“Health committee might attempt to curtail use of penicillin and tetracycline in feeds,” *Science* , July 18, 1980, #3209, p. 481.

Bernstein, I., & Sigmundi, R. *Science* , #209, July 18, 1980, p. 416. There is evidence that a tumor will induce changes in taste.

Science , May 23, 1980, vol. 208, p. 826-28. A very extensive report discussing the reliability of new compounds being developed to replace worn out ones in body. June, 1980, #401, p. 208, describes how genetic variation affects enzyme structure or changes protein metabolism.

Blaine, Tom & Hoffer, A. *A Mental Health Through Nutrition* . Citadel Press, N.Y., 1975. Author shows how diet can influence mental health, even though this is a highly debated subject; this is a new approach in biological psychiatry, perhaps a cure for depression.

Chapple, Mitchell. *Heart Songs* , Boston Mass., 1937, p. 140. “0 Dear What Can the Matter Be?” An old ballad which might introduce this unit.

Clark, Goaqwll, Shapiro, Huck, Morbach. “Drugs and Psychiatry.” *Newsweek* , Nov. 12, 1979, pp. 98-104. Excellent biochemical discussion of mental illness; reference to research at Yale. Pupils might find parts interesting, gives hope to mentally ill.

Crossland, Maurice. *The Science of Matter* . History and survey with selected readings. Harmondsworth, Penguin, 1971.

“Drug blocks biosyntheses cholesterol.” *Chemistry and Engineering* News, June 23, 1980, vol. 58, #25, p. 39. Maybe we’ll eliminate another cardiac factor!

Drug Therapy . Journal of Prescribing Information, Vol. 10, #6, June, 1980, p. 11. Lead is found in milk from cans of formula, as the edge is soldered. p. 19, holistic medicine, stresses that it is the individuals duty to stay well, and not expect the M.D. to correct the damage. p. 45, the acid content of the eye is a healthy sign.

Eggins, B. *Chemical Structure and Reactivity* , Barnes & Noble, 1977.

Fano. *Physics of Atoms and Molecules* . University of Chicago Press, 1972. Adult level only.

Fermi, E. *Elementary Particles* . Yale University Press, 1961. Not so elementary.

Gamow, George. *Matter, Earth and Sky* . Prentice-Hall, 1965. Good teacher reference even though not too modern.

Geier, A. & Lamm, N. *Mathematics and your Career* , Amsco School Publications, 1978. Many careers grouped in 15 major groups, with each chapter introducing topics and associated careers, good reference.

Gibson, John. *Nurses Materia Medica* . Blanchinell Scientific Pub., London, 1976. An aid to teachers, dealing with drugs, individual responses, and dangers. Compact.

Jackson, Kevin, Rudnick, N., Hyman, R. *Experience With Everyday Objects* . Prentice-Hall, N.J., 1978. Fun experiments for teacher and student, especially p. 120, mothball race, and p. 122, coloring liquids.

Kalsner, Stanley, Chai, Chi-Chung, "Inhibition by Dopamine of the effect of 3H Noradrenaline," *Canadian Journal of Physiology and Pharmacy* , Vol. 58, #5, pp. 504-511. Behavior of drugs which interact with the neuronal release system, a detailed report.

Kisch, Bruno. *Scales and Weights* . Yale University Press, July, 1966, 92nd printing. Excellent history of weighing. Photographs. Reference to Streeter collection of measuring and weighing devices on display in Yale Medical History Library.

Keller, J.J. & Associates. *Official Metric System* . Keller Assoc. Pub. Neenah, Wisconsin, 1975. A quick source of information on metric system and application utilizing charts, conversion factors, and definitions.

Krauskopf and Beiser. *The Physical Universe* . McGraw-Hill, 1960. Helpful, best for teacher, historical data.

Levine, Ruth R. *Pharmacology Drug Actions and Reactions* . Little Brown, 1973. Excellent source; historical, and exceedingly detailed. In depth discussion of chemicals and their effect on the body.

Lowery, L.F. *The Everyday Science Book* . Allyn & Bacon, 1978. Excellent sourcebook for teachers and students. Ideas for teaching elementary and middle school science; hundreds of experiments.

Margenau, Henry. *Ethics of Science* . Robert Kreiger Pub. Co., Huntington, New York, 1979. Excellent, provocative, detailed description of parallelism between ethics and science, and differences; science states a fact, ethics appeals to human nature (first time I knew an author who's a neighbor).

Conradie, J.D. "Recent Developments of Blood Transfusion," *South African Journal of Science* , April, 1976, pp. 149-150. Discussion of uses and parts of blood uncommonly known, for ex. antibodies for anti-tetanus injections, monitoring of Fe of blood donors, so they don't become anemic. p. 154, Heat Intolerance:. Its Detection and Elimination in the mining industry; heat intolerance men have lower maximum oxygen intake than heat tolerant counterparts. Underweight men develop heat stroke on first exposure to heat, and failed to acclimate in normal way. Very helpful.

May, Albert. "Psychiatry-Is there really a method?" St. Raphael's Hospital Magazine, Summer, 1978, p. 6. The state's biggest development in psychiatry has been in drugs in the last twelve years.

Muntya. *Applied Biochemistry and Microbiology* , vol. 15, #5. "Decomposition of Cholesterol continued in human blood." *New York Times* , "Evidence Builds Against Marijuana," May 21, 1980, and "Lead Persists Threat to Young."

“Nitrites,” *New York Academy of Science* , May/June, 1980, p. 2. Article states there is a direct relationship between nitrites and cancer.

Polya, F. *How to Solve It* . Princeton Press, Princeton, N.J., 1973(2). How a teacher can challenge a student to solve problems. Helpful.

“Psychiatry’s Depression,” *Time* , Vol. 113, #14, pp. 74-82. Excellent article, excellent diagrams, superior discussion of chemistry of brain; where dopamine is suspected as the culprit in disabling mentally depressed, and hope for more chemicals to prevent depression and improve behavior is expressed.

Rutheroford, Ernest. *A bibliography of his technical writings* . Office of History of Science and Technology, Univ. of Calif., 1979. Paperback.

Schrodinger, Ervin. *What Is Life? Mind and Matter* . Cambridge Univ. Press, 1951 (On display in Yale Med. school rotunda), a classic in its field, if you can find it (5 copies are missing from Yale Med. School).

Shapely, Harlow. *New Treasury of Science* . Harper & Rowe, 1965.

Sizer, Irwin. “Technology and the Quality of Life,” *Science* , Feb., 1980, p. 21. Very good article dealing with effect of science on life.

Slater, John Clarke. *Quantum Theory of Matter* , McGraw-Hill, 1968. More detailed and advanced.

Svent-Gyorgi. *Lost in the 20th Century* , 1965. Excitement and fascination of science; many brief quotable phrases make for exciting reading.

Thompson, John D. Professor of Hospital Administration Yale Medical School. Many helpful suggestions.

Tobias, Sheila. *Overcoming Math Anxiety* . W. Norton Co., N.Y., 1978. Very good; this may help many.

Traub. “Flourishing like Weeds,” Barron’s, July 14, 1980, pp. 9, 10, 28, 30. Excellent social and economic analysis of the drug and paraphernalia business (drug paraphernalia shops are also known as “head shops”).

Science . Jan. 1980, Vol. 207, #4426, p. 28. Cigarette smoking associated with sleep difficulty.

Feb. 22, 1980, p. 859. Why aspirin works in the brain but not in the heart is unclear.

April 11, 1980, Vol. 208, #4440, p. 198. Mg. deficiency produces spasms of coronary artery.

June 6, 1980, Vol. 208, p. 1127. Calcium now helps control angina.

July 4, 1980, “Centennial Edition,” Vol. 207, #4452, entire edition is stuffed with excellent material from Feedstock in transition, so as the knowledge of chemistry in biology increases so the ability to design molecules for medicinal and agricultural uses develops. A copy worth having.

Trends in Neuro Science . June, 1980. Biomedical press, Vol. 3, #6, p. 1. World Health organization found 1% of the population has schizophrenia, and is studying this all over the world to control, or learn how to control this, by studying populations and the different cultures.

p. 154, Malaria to pathologic problems because of inadequate oxygen supply at that time.

Yianilos, Theresa Spero, J. Educational Associates, 1976. This source book for teachers and some students is excellent in its study of

poisonous plants, and lists of medical uses of plants.