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R.E.A.L. SCIENCE ODYSSEY

Chemistry (level one)

RSO Chemistry

for Grades 2 – 5

R.E.A.L. SCIENCE ODYSSEY - Read • Explore • Absorb • Learn

Pandia Press

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R.E.A.L. Science Odyssey

- Read
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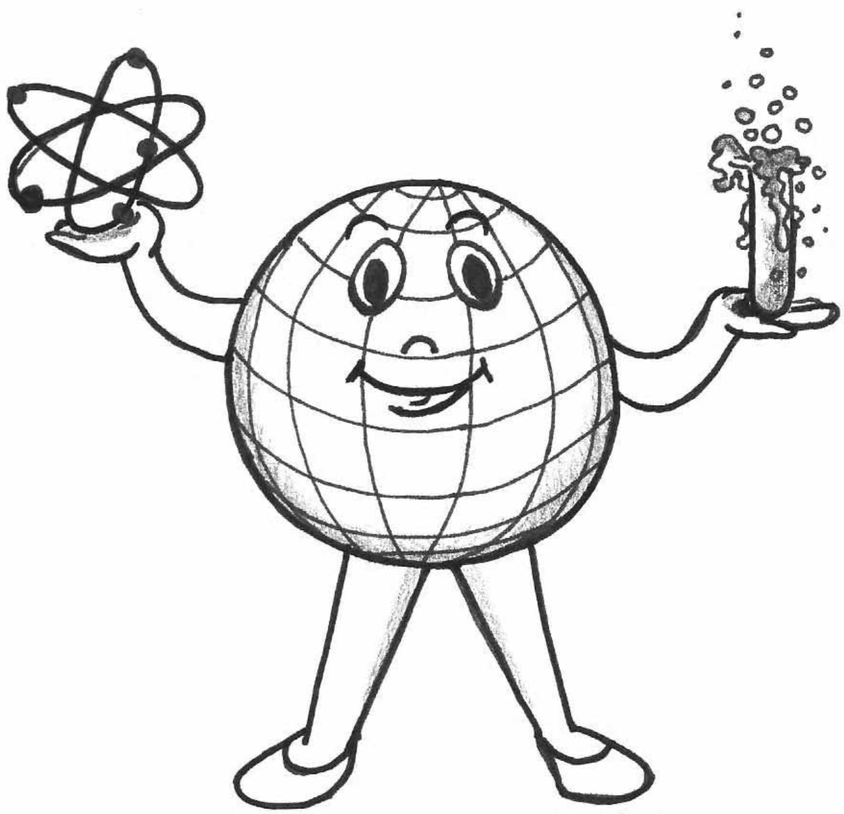

RSO Chemistry

(level one)

for Grades 2 – 5

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WHAT'S INSIDE THIS BOOK?

•Denotes "For My Notebook" lesson page *Denotes lab or activity

An Introduction to RSO Chemistry

Atoms, molecules, chemical reactions, the periodic table—concepts intimidating enough to make a person weak in the knees! Young children can learn chemistry! Students as young as seven years old can successfully complete this course even though many of the concepts taught in this book are those usually reserved for high school. Don't worry, this book is written with the science novice in mind. Even if you have never been taught chemistry or don't know an electron from a proton, you will find yourself learning right alongside your child, and looking like a pro the whole time! You and your child will never look at a common piece of matter (like your shoe) the same again, without thinking about the billions and billions of molecules and atoms that make it up.

This course is not a collection of random labs, meant to entertain but with little real science. Nor is it a long progression of fill-in-the-blanks and trivial facts to be memorized and forgotten. Instead, this book is rich in vital concepts that will lay a firm foundation for studying chemistry in later years. This book is intended to be used from start to finish, like a math book. Concepts are taught through clever repetition and engaging labs, building upon one another and introducing science vocabulary and age-appropriate math gently and in context. There is particular emphasis placed on scientific method throughout this course. Students will learn how to speculate, hypothesize, experiment, observe, interpret, and conclude just like real scientists.

A good chunk of this course is devoted to learning about the periodic table and studying several important elements on the table. Any serious study of chemistry must include the periodic table. It is the chemist's alphabet and it is as vital to chemistry as letters are to literature. When students are in a chemistry class later in life, they will have the background to advance farther; they will not fear the table.

There is evidence that science is best learned when taught as a single subject and not lumped together with multiple mini-subjects taught in the span of a school year. That said, all the sciences do interrelate. Chemistry is the study of atoms, what they make, and how they interact. Since everything is made from atoms, the argument can be made that chemistry is the central science. Unfortunately, it is the science least likely to be taught before high school. The problem with that is, if you try to understand a scientific concept with any degree of depth, you had better know some chemistry. I have thought for some time now that educators start teaching chemistry too late. It is a fascinating subject, but there are new facts and new vocabulary, and you are learning about things that are the size of an atom—way too small to see! With chemistry, more than any other science, you often have to memorize a fact and take scientists' word for what is happening. The time to do that is not when someone is in high school or college; it is when a child is in the beginning stage of learning. This is the ideal time for absorbing facts, memorizing content, and filling a child's mind with the knowledge that creates a firm foundation for later years.

While creating this book, a lot of thought was given to teaching to the three main learning styles—visual, auditory, and tactile/kinesthetic. Science, by its very nature, lends itself to teaching to all three styles. With that in mind, each lesson in this book has visual, auditory, and tactile components. For visual learners, there are diagrams and charts that students help create and visualize. There are illustrations coupled with the text. There are crossword puzzles to help learn vocabulary words. The experiments have been carefully selected and designed to support the concepts taught in the text. Therefore, the experiments themselves are powerful visual aids.

For auditory learners, those who learn best through listening, there is the text itself, which has been designed to be read to students. There is a poem in each unit of this book to help reinforce vocabulary and key concepts. There are questions peppered throughout the text and within the experiments to help these students think through and hear the answers, thereby cementing the concepts being taught in an auditory fashion.

For tactile/kinesthetic learners, those who learn through moving, doing, and actively exploring the physical world, this book has been designed for them as well. There are activities that use movement to teach concepts. There are drawings and models to make. There are puzzles for students to put together. There are diagrams and charts to create. There are hands-on labs to perform which directly teach to the concepts.

Science is a creative and thought-provoking endeavor. It is the one academic subject where you are supposed to move around and get your hands dirty. With such an emphasis on test scores these days, it seems breadth and depth in academics has been forgotten. It is time to bring science back as a core part of curriculum, engaging young people's minds with the stuff they really find interesting. Let's get started!

THE UNIQUE PAGES IN THIS BOOK

For My Notebook Pages

1. All the student pages have a boxed outline around the material presented. That way it is easy to identify what is for the child and what is for the parent or teacher.
2. The For My Notebook (FMN) pages are the lesson pages that present the majority of new material to the student. They are intended to be read aloud. Some students, who are good readers, may want to read the FMN pages aloud themselves to the parent or class. However orchestrated, these pages are intended to be read aloud and not silently to encourage discussion and questions.
3. New vocabulary words are underlined. You will notice that many of the vocabulary words are not presented with a classic dictionary definition. Instead, the explanation is given in context so it is "felt" rather than memorized. Formal definitions for the vocabulary words are offered in the back of the book.

Lab Sheets

1. The lab sheets are those pages that the student writes on. They also have a boxed outline because they are intended for the student, not the parent/teacher, to complete.
2. The lab sheets not only reinforce the material presented in the FMN pages, but they are also the vehicle through which this course reinforces and formalizes scientific method. On the lab sheets, students will be making hypotheses based on questions formed during the lesson. Students record observations and lab results, and make conclusions based on those results. They will also practice sketching details of their lab experiences, an important process that reinforces observation skills.
3. If you are working with a student who isn't writing yet, then have him dictate the information to be written on the lab sheets. If your student is unable to draw (meaning physically incapable; I'm not referring to artistic abilities), then have him describe in detail his observations as you create them on the lab sheet.

The Instructor Pages

1. The instructor pages contain the supply lists for the labs or activities and procedure instructions.
2. These pages are written for the parent/teacher, but the procedure is often written as if for the student. For example, "Complete the hypothesis portion of the lab sheet," is instruction for the student, not the parent.
3. Most instruction pages include a prompt to read aloud to students. A great deal of course instruction is found in these prompts. If you dislike prompts, then be sure to present the information in your own words.

Poem Pages and Crossword Puzzles

1. Each unit contains a poem and a crossword puzzle that are intended to help reinforce vocabulary and key concepts.
2. The poems can be used as you wish—recite, memorize, transcribe, illustrate. Concepts learned to verse are learned more quickly and not as easily forgotten.
3. The crossword puzzles review the vocabulary presented in each unit.

WHAT'S THE BIG IDEA?

Whenever you study a subject, there are main ideas and details to learn. It's true, that in science, there is a lot of new material to discover. If you are using a classical education approach to teaching, you will cover every subject three times throughout your child's education. Because of this, don't sweat the small stuff. This outline gives you the big ideas that your child should get from each unit and the small stuff that is an added bonus. If you and your child are timid scientists, just have fun as you try to learn the big ideas. If you and your child have a strong science background, work on learning the small stuff as well as the big ideas. There are many challenging words in this course that are used because they are the right words, and after hearing them over and over, they will "sink in." They are not here for your child to memorize the first time around. Use difficult words and science concepts gently, not with force, and your child will enjoy his science experience.

BI = BIG IDEA **SS = SMALL STUFF**

UNIT 1 - WHAT IS CHEMISTRY?

WHAT IS CHEMISTRY?

BI = All things are made of chemicals.
Chemistry is the science that studies chemicals.
A chemist is a person who studies how chemicals interact.
A hypothesis is your best guess about the outcome of an experiment.

SS = Chemist's use two types of tests to tell different things apart—physical tests and chemical tests.
Most chemicals are benign.

UNIT 2 - STARTING SMALL

THE ATOM

BI = Atoms are extremely small.
Everything is made of atoms.
Atoms move.

SS = A Greek philosopher named Democritus talked about the concept of atoms 2,400 years ago.
Temperature affects how fast atoms move and the rate of diffusion.
A scanning-tunneling microscope is needed to see atoms.

PARTS!

BI = The three parts of an atom are protons, neutrons, and electrons.
Protons and neutrons are found in the nucleus.
Electrons are found orbiting the nucleus in energy levels.
All protons, neutrons, and electrons are like every other proton, neutron, and electron.

SS = Protons and electrons are charged particles.
Atoms are mostly empty space.

TYPES!

BI = Each type of atom has a unique name.
The thing that makes one type of atom different from another type of atom is the number of protons that the atom has in its nucleus.
The number of electrons a neutral atom has is the same as the number of protons in its nucleus.
An element is a group of the same type of atoms.

SS = A maximum of two electrons go in the first energy level. A maximum of eight electrons go in the second energy level.
When going from one type of atom to the next, one and only one proton is added to nucleus.
Most atoms have more than one energy level.

UNIT 3 - THE CHEMIST'S ALPHABET DEFINED

THE ALPHABET

BI = The periodic table is a chart that has the names of all the elements on it.
Everything is made from these elements.
Elements are on the periodic table in abbreviated forms, called symbols.

SS = Dmitri Mendeleev invented the periodic table.
Some symbols come from names of the elements that are still used today.
Some symbols come from earlier names used for the element.

ATOMIC NUMBERS

BI = The atomic number is found on your periodic table above the symbol for the element.
The atomic number equals the number of protons in the nucleus of that type of atom.
The number of electrons in an atom's elemental form equals the atomic number.

SS = If something is an element, all parts of it will react the same in a chemical test.
When going from one element to the next one on the periodic table, one proton is added to the nucleus.

MASSIVE MATTERS

BI = The atomic mass of an element equals the number of protons + the number of neutrons.
Mass is the same anywhere in the universe. Weight is affected by gravity.

SS = Things that take up the same amount of space can have different masses.
If the number of the same type of atoms stays constant, the liquid state weighs the same as the solid state.
a.m.u. = atomic mass unit. It is the unit used to measure the atomic mass of an atom.

WHY DO THEY CALL IT THE PERIODIC TABLE ANYWAY?

BI = The rows of the periodic table are called periods.
There are seven periods on the periodic table.
The periodic table is read from left to right and down, like a book.

SS = The period an element is in equals the number of energy levels it has.

WE ARE FAMILY

BI = The columns of the periodic table are called groups.
Elements in the same group on the periodic table share traits with each other.
There are 18 groups on the periodic table.

SS = Elements in the same group have the same number of electrons in their outer energy level.

IT'S ELEMENTARY

BI = The top three rows (periods) on the periodic table have 18 commonly occurring elements.

SS = 92 of the 118 elements are naturally occurring, the rest are man-made.

UNIT 4 - THE CHEMIST'S ALPHABET APPLIED

Unit 4 is a step by step, group by group, explanation of how the elements on the Periodic Table are arranged based on their structure.

BI = One and only one proton is added to the nucleus of an element when going from one element to the next on the periodic table.
The number of protons in an element's nucleus equals its atomic number.
The atomic mass of an element equals the atomic number plus the number of neutrons.
The total number of electrons for elements on the periodic table equals the number of protons for that element.
All elements in the same group have the same number of electrons in their outer energy level.

SS = The number of neutrons does not increase consistently, but does increase overall.

HE LIKES NACHOS – GROUP 1

BI = Introduction to the elements hydrogen, lithium, and sodium.

SS = Things are more buoyant in NaCl + water than in water alone.

BE MGNIFICENT - GROUP 2

BI = Introduction to the elements beryllium and magnesium.

SS = A solution = solute + solvent.
Water is the universal solvent.

BUMBLEBEES ALIGHT – GROUP 13

BI = Introduction to the elements boron and aluminum.

CONSTANTLY SILLY – GROUP 14

BI = Introduction to the elements carbon and silicon.

SS = Carbon browns when heated.
Sugar is made from carbon, hydrogen, and oxygen.

NICE PENGUINS – GROUP 15

BI = Introduction to the elements nitrogen and phosphorus.

OBNOXIOUS SEAGULLS – GROUP 16

BI = Introduction to the elements oxygen and sulfur.

SS = When hydrogen peroxide bubbles it is turning into water and O_2.
Hydrogen peroxide bubbles on cuts because of catalase in your blood, not germs in the cut.

FREQUENTLY CLEVER – GROUP 17

BI = Introduction to the elements fluorine and chlorine.

SS = Fluorine bonds to calcium in teeth making teeth stronger.

HE NEVER ARGUES – GROUP 18

BI = Introduction to the elements helium, neon, and argon.

SS = Gas shrinks (has a smaller volume) when it is cold.

UNIT 5 - MOLECULES RULE

PUTTING IT ALL TOGETHER

BI = Atoms bond (link) together and make molecules.
The bonds form when atoms share electrons from their outer energy levels.

SS = A compound is a group of all the same type of molecules.
A mixture is a group of different types of molecules.

MOLECULAR FORMULAS

BI = Molecular formulas tell the amount and type of atoms present in a molecule.
To write a molecular formula, write the symbol for the element and the number of atoms present.

SS = Capillary action in plants is a result of the interaction between water molecules and the cellulose molecules in the plant.

DRAWING LESSONS

BI = There is a special method for drawing molecules called Electron Dot Structures.
When drawing molecules, place the atoms so they are sharing electrons on the side where there is a single electron.

SS = Electron Dot Structures pair electrons from different atoms using only electrons in the atoms' outer energy levels.
The rate of capillary action can be affected by how "sticky" water finds molecules it encounters.

UNIT 6 - WHAT'S THE MATTER?

MATTER: AN INTRODUCTION

BI = Protons + neutrons + electrons make atoms. Atoms group together to make molecules. Molecules group together to make matter.

SS = Sometimes when two different types of molecules get together, they switch atoms around and make different molecules. When this happens, it is called a chemical reaction.
When chemical reactions happen, atoms cannot be created or destroyed.
John Dalton wrote the Atomic Theory of Matter in 1766.

THE STATES OF MATTER

BI = Matter is anything that takes up space and has mass (weight).
Matter comes in three states—solid, liquid, and gas.
The three states of matter are differentiated by the physical properties of definite shape and volume.

SS = Water is found in all three states—ice, liquid water, and steam—over the normal temperature range.

LET'S GET TO THE POINT

BI = The special name for the point where matter goes from solid to a liquid = melting point.
The special name for the point where matter goes from liquid to a solid = freezing point.
The special name for the point where matter goes from gas to a liquid = condensation point.
The special name for the point where matter goes from liquid to a gas = boiling point.

SS = The temperature of the freezing point = the temperature of the melting point.
The temperature of the boiling point = the temperature of the condensation point.
The melting point of water = freezing point = 32°F (0°C)
Boiling point of water = condensation point = 212°F (100°C)
Some matter does not fall completely into one of the three defined states.

SOLIDS ARE DENSE

BI = The molecules in a solid are close together.
The molecules in a solid do not move much, they vibrate slightly and have a fixed position relative to each other.
Solids are more dense than gases.
Density = the amount of stuff in a given space.

SS = Solids have a definite shape and a definite volume.
Solids are more dense than liquids, with the important exception of water.
Density is affected by the amount and type of molecules or elements present.

MOLECULES STICK TOGETHER

BI = Molecules stick together by sharing electrons.

SS = Molecules in solids are close together and don't move much.
Molecules in liquids are farther apart and move more.
Molecules in gases are not very close together—they move a lot.

WHAT MAKES A LIQUID A LIQUID?

BI = The molecules in a liquid are close together but not as close as in a solid.
The molecules in a liquid move around but not as much as in a gas.
Liquids have a definite volume, but not a definite shape.

SS = Different types of liquids can have different densities.

THE FRIENDSHIP OF OXYGEN AND HYDROGEN

BI = Water is an important and unique compound. It is essential to life, as we know it.

SS = Hydrogen bonds hold water molecules together.
Because ice is less dense than liquid water, the same number of molecules in ice has a greater volume than those molecules in liquid water.
Water can be separated into hydrogen and oxygen gases through a process called electrolysis.

WHAT MAKES A GAS A GAS?

BI = The molecules in a gas have a lot of space between them.
The molecules in a gas are fluid, move very fast, and mix freely.
Gases do not have a definite volume or a definite shape.
Gases are less dense than solids and liquids.

SS = Because gases are less dense than liquids, they will float to the top and out of a liquid.

THE AIR YOU BREATHE

BI = Oxygen is essential to life.
Air takes up space.

SS = Air is 78% nitrogen and 21% oxygen,
Oxygen is cycled between people, animals, and plants.
Air is important for regulating the temperature on earth.

UNIT 7 - REACTIONS IN ACTION

CHANGES

BI = Chemical change = chemical reaction
In a chemical reaction, the molecules at the beginning are not the same as those at the end. The same atoms are there, but they are bonded differently.
When there is a physical change, the molecules present do not change.
In a chemical reaction, the starting molecules are called reactants.
In a chemical reaction, the ending molecules are called products.

SS = Evidence of chemical change = temperature change, the formation of bubbles, or a solid forming.
Chemical reactions are written as equations.
Exothermic reactions release heat.
Endothermic reactions absorb heat.

SOME LIKE IT SOUR, SOME DON'T

BI = Acids taste sour.
Bases taste bitter and feel slippery.
Indicators tell if a solution is an acid, a base, or neutral.

SS = In acids, the hydrogen atom comes off in a solution and leaves an electron. This is called a dissociation reaction.
In bases, the oxygen and hydrogen atoms come off in solution and take electrons. This is also called a dissociation reaction.

HYDROGEN AND OXYGEN AND HYDROGEN MAKE WATER

BI = acid + base = water + salt = an acid-base reaction

SS = H without its electron (from an acid) and OH with an electron (from a base) makes H_2O.
If an acid and a base solution are mixed, and the resulting solution is neutral, it is called a neutralization reaction.

pHUNNY pHRIENDS

BI = The pH scale is used to measure the strength of an acid or a base.

SS = The pH scale measures from 0 to 14.
7 is neutral.
Less than 7 is an acid.
Greater than 7 is a base.

BUILDING TEETH

BI = In precipitation reactions, different liquids are mixed together and one of the products formed is a solid.

SS = Precipitation reactions are the type of chemical reactions used to make bones, teeth, shells, and coral reefs.

COMBUSTION ACTION

BI = Combustion reactions must have oxygen gas as one of its reactants.

SS = Combustion reactions are exothermic.
If oxygen gas is taken away, the fire goes out and the reaction stops.

Lab Supply List

Items are listed by unit in the order in which they are first needed. + means an item will be needed for later labs also. The amounts listed are totals for the entire course. Most items are common household items.
* means the item requires some explanation. Ordering hints or explanations are given on the next page.

UNIT	EQUIPMENT / MATERIAL	AMOUNT
1+	Teaspoon	3
1+	Clear glass	3
1	Dish	3
1+	Kitchen towel	1
1	Box of cereal	1
1+	Confectionery sugar	2 ¾ cups
1+	Baking powder	1 cup
1	Baby powder	¾ cup
1+	White vinegar	5 cups
1+	Cooking oil (vegetable oil)	2 cups
1+	Food coloring (blue)	1 bottle
1	Dish soap	1
2+	Balloons	6
2	Almond extract	1 T
2+	Water (tap)	1 -2 gallons
2+	Cinnamon	2 T
2	Lemon, orange, or peppermint extract	1 T
2+	Magnifying glass (hand lens)	1
2	½ teaspoon measuring spoon	1
2	Permanent marker	1
2+	Crayons or colored pencils	1 box
2	Construction Paper (8 ½" x 11")	1
2+	School glue (Elmer's glue)	2 bottles
2	Inflated balloon	1
2	Mirror	1
2	Carpet or fabric sofa	1
2	Aluminum foil	
2	Pencil lead or a sharpened pencil	1
2	Mini marshmallows (all one color)	1 bag
2+	Regular-size marshmallows (two colors)	2 bags + 4
2+	Blank sheets of paper 8 ½" x 11"	20
2+	Kitchen scale that measures grams	1
2+	Scissors	1
3+	Lemon juice	1 cup
3+	Paintbrush	1
3+	Heat source, such as a lamp	1
3+	Pot holder	2
3+	Milk	1 ½ cup
3+	Measuring cup	various sizes
3+	Stapler	1
3+	Internet access	
3+	Chemistry books/encyclopedias	
3	Frozen water in a baggie	1 cup
3	Brown sugar	1 cup
3	Grapes	1 cup
3	Grape juice	1 cup

UNIT	EQUIPMENT / MATERIAL	AMOUNT
3+	Re-sealable baggies	10
3+	Peanut butter	1 small jar
3	Powdered milk	1 cup
3	Honey	¼ cup
3+	Wooden spoon	1
3+	One-gallon freezer baggie	4
3+	Mixing bowl	1
3+	Tablespoon	1
3+	Fork	1
3+	Table salt	1 ½ cups
3	Salt substitute (potassium chloride)	¼ cup
3	Cooked potato	1
3	Crushed ice	2 cups
3+	Small cup	2
3	1/8 teaspoon measuring spoon	1
3+	Thermometer (science or kitchen-type*)	2
3+	Eggs	7
3+	Flour	3 cups
3+	Granulated sugar	5 cups
3	Cinnamon sugar (optional)	1 T
3	Muffin pan	1
3	Muffin cup liners	12
3	Whisk	1
3+	Oven and stove top with a timer	1
4	12" x 12" card stock (different colors)	10 sheets
4	Glue stick	1
4+	Distilled water	10 cups
4	Epsom salt	3 T
4	Black construction paper 8 ½" x 11"	1
4	20 Mule Team Borax*	2 t
4	Grated Styrofoam or polystyrene beads*	1 cup
4+	Food coloring	1 bottle
4	Small cake pan	1
4	Graham crackers	2
4+	Baking sheet / cookie sheet	1
4	Brown colored pencil	1
4	Egg whites	3
4	Parchment paper	
4	Shortening or nonstick spray	
4	Electric mixer	1
4+	Pot	1
4+	Knife	1
4+	Hydrogen peroxide	1 bottle
4	Raw potato	1
4+	Sink or work bucket	1
4	Bleach	½ cup

UNIT	EQUIPMENT / MATERIAL	AMOUNT
4	Eyedropper	1
4	Fluoridated toothpaste	4.6 oz.
4	Toothbrush	1
4	Colored nail polish	
4	Plastic wrap	
4	Helium-filled balloons	2
4	Flexible cloth tape measure	1
4+	Freezer	1
5	8 ½" x 11" card stock	1
5	Bag of gumdrops (assorted colors)	1
5	Toothpicks	1 box
5	Pepper	½ t
5	Lettuce	1 head
5	Tomato	1
5	Carrot	1
5	Salad bowl	1
5	Stalk of celery	1
5+	Chalkboard or dry erase board	1
5	WHITE paper towel with NO designs on it	1
5	Shallow dishes	3
5	Q-tip	1
5	Ruler	1
5+	Tape	
6	Lego pieces	10 – 15
6	Ice cubes	2 cups
6	Rock	1
6	Drinking straw (optional)	1
6	Crushed ice	1 cup
6	Jell-O	1 box
6	Cold water	1 cup
6+	Hot water	2 cups
6	Mayonnaise	1 T
6+	Refrigerator	1
6	Plate	1
6	Medium-sized box or container	1
6	Stuffed animals	10
6	Wash tub, bathtub, or sink filled with water	1
6+	Orange	2
6	Small (1- to 2-cup size) plastic container	1
6	Marbles	10 – 20
6	Assortment of water-proof solids	8
6+	Quart-size glass jar with lid	1
6	6-inch long piece of rough string or yarn	1
6	Clean metal washer or a Lifesaver candy	1
6	Funnel (optional)	1
6	Corn syrup	¼ cup
6	Clear 2-cup container	1
6	Empty plastic soda bottles	2
6	Pan for under soda bottles	1

UNIT	EQUIPMENT / MATERIAL	AMOUNT
6	6-inch insulated copper wires	2
6	9-volt battery	1
6	Can of soda	1
6	Popping corn	1 cup
6	Empty 2-liter soda bottle	1
7	Alka-Seltzer tablet	1
7+	Matches or lighter	1
7	Kool-Aid	2 packs
7+	Pitcher with pour spout	1
7	Bubble-blowing solution and wand	1
7	Cast-iron skillet or fire-proof container	1
7	Yeast	1 t
7	Clear measuring cup	1
7+	Baking soda	11 t
7	Head of **red** cabbage	1
7	Strainer	1
7	Large 8-cup container with a cover	1
7	White coffee filters	2
7	Rubber gloves	1 pair
7	Ammonia	2 t
7	Laundry detergent	1 t
7	7-Up	1 t
7	Clear plastic disposable cups	10
7	Newspaper	1
7	Red, blue, and white watercolor paint	1 T of each
7	Paint palette	1
7	Lemon	1
7	Grapefruit	1
7	Lime	1
7	Cherry Tomato	1
7	V-8 Juice	1 cup
7	Chalk	6 pieces
7	Different size glass jars	3
7	Roasting pan	1
7	Sand	5 cups
7	Votive candles	3
7	Stopwatch	1
7	Dollar bill	1
7	Tongs	1
7	91% Rubbing alcohol	½ cup

Ordering Hints:

Thermometer: A good science thermometer goes down on its own, unlike a medical thermometer, which must be shaken down. Some kitchen thermometers will work, but most do not go low enough. You will need a thermometer that will go down to 30° F or 0° C.

20 Mule Team Borax: A laundry booster found next to laundry detergents in grocery stores.

Polystyrene beads: Used for stuffing stuffed animals. Found in some craft stores in the sewing section. Grated Styrofoam is an excellent substitute.

Suggested Weekly Schedule

The following schedule is suggested for those wishing to complete this course in a 36-week school year, teaching science twice a week. General supplies needed for each week are listed. Refer to the lesson or supply list for specifics on supplies including quantities. FMN indicates For My Notebook lesson pages.

Week	Day	Lesson / Lab	Supplies Needed for the Week	Dates / Notes
1	Day 1	What Is Chemistry? (FMN) Be a Chemical Detective	Box of cereal, Confectionery sugar, Baking powder, Baby powder, Water, Vinegar, Cooking oil, Blue food coloring, Teaspoons, Pour container, Clear glasses, Dishes, Kitchen towel, Sink, Dish soap	
	Day 2	Telling Things Apart		
2	Day 1	The Atom (FMN) Are Atoms Small?	Balloons, Almond extract, Water, Cinnamon, Lemon or peppermint extract, Magnifying glass, Measuring spoon, Permanent marker, Water at three temperatures, Food coloring, Clear glasses, Thermometer, Colored pencils	
	Day 2	Do Atoms *Move*?		
3	Day 1	Parts! Let's Be Positive	Crayons or colored pencils, Construction paper, Glue, Inflated balloon, Wall, Mirror, Carpet or fabric sofa, Large work surface, Aluminum foil, Pencil lead, Mini marshmallows, Regular-size marshmallows, Blank sheets of paper, Kitchen scale, Scissors	
	Day 2	Types! (FMN) The First Ten		
4	Day 1	The Alphabet (FMN) My Periodic Table	Lemon juice, Paintbrush or cotton swab, Sunlight or lamp, Periodic table, Pot holder	
	Day 2	Chemical Symbol Match My Favorite Element		
5	Day 1	Atomic Numbers (FMN) Is Milk an Element?	Milk, Glass, Lemon juice, Measuring cup, Scissors, Colored pencils, Stapler	
	Day 2	Flipbook		
6	Day 1	Massive Matters (FMN) My Favorite Element Explored	Internet access and/or chemistry books, Colored pencils or crayons, Water (frozen), Liquid water, Powdered Sugar, Brown sugar, Grapes, Grape juice, Kitchen scale, Measuring cup, Sealable baggies	
	Day 2	Which Weighs More?		
7	Day 1	Why Do They Call It the Periodic Table Anyway? (FMN) Periodic Table Worksheet	Periodic table, Peanut butter, Honey, Powdered milk, Sealable baggie, Mixing bowl, Measuring cup, Wooden spoon	
	Day 2	Periodic Play Dough		
8	Day 1	We are Family (FMN) The Friendship of Beryllium and Boron	Periodic table, Table salt, Salt substitute (potassium chloride), Oil, Vinegar, Cooked potato (optional), Water, Crushed ice, Glass, Cups, Measuring spoon, Towel, Science or kitchen thermometer	
	Day 2	Prove It!		
9	Day 1	It's Elementary (FMN) Twenty Questions	Periodic table, Flour, Salt, Cinnamon, Eggs, Sugar, Milk, Vegetable oil, Baking powder, Cinnamon sugar (optional), Muffin pan, Muffin cup liners, Mixing bowls, Whisk, Measuring cup, Measuring spoon, Oven, Hot pads	
	Day 2	Eating Hockey Pucks		
10	Day 1	Element Book He Likes Nachos - Group 1 (FMN)	Periodic table, 12" x 12" card stock, Scissors, Glue stick, Stapler, Art supplies (markers, colored pencils, crayons), Eggs, Tall clear glasses, Distilled water, Salt, Tablespoon, Stirrer	
	Day 2	The Incredible Floating Egg Element Book Group 1		
11	Day 1	Be Mgnificent - Group 2 (FMN) Crystal Creation	Epsom salt, Black construction paper, Warm water, Magnifying glass, Measuring cup, Tablespoon, Cake pan, Scissors, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Element Book Group 2		

Week	Day	Lesson / Lab	Supplies Needed for the Week	Dates / Notes
12	Day 1	Bumblebees Alight - Group 13 (FMN) The Slime That Ate Slovenia	20 Mule Team Borax, Water, White school glue, Grated Styrofoam or polystyrene beads, Food coloring (optional), Freezer baggie, Mixing bowl, Measuring cup, Teaspoon, Tablespoon, Fork, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Element Book Group 13		
13	Day 1	Constantly Silly - Group 14 (FMN) S'more Carbon	Large marshmallows, Graham crackers, Baking sheet, Oven, Hot pad, Brown colored pencil, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Element Book Group 14		
14	Day 1	Nice Penguins - Group 15 (FMN) Eating Air	Egg whites, Confectionery sugar, Parchment paper, Nonstick spray, Flour, Cookie sheet, Mixing bowl, Fork, Spoon, Electric mixer, Oven, hot pads, Magnifying glass, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Element Book Group 15		
15	Day 1	Obnoxious Seagulls - Group 16 (FMN) That's Not My Egg You're Cooking, Is It?	Eggs, Clear glass, Heat source, Pan, Water, Timer, Salt, Knife, Hydrogen peroxide, Raw potato, Sink, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Bubble Trouble Element Book Group 16		
16	Day 1	Frequently Clever - Group 17 (FMN) Dancing Drops	Bleach, Dark food coloring, Water, Glass, Eyedropper, Toothpaste, Egg, Vinegar, Glass, Water, Toothbrush, Spoon, Colored nail polish, Plastic wrap, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	The Tooth, the Whole Tooth, . . . Element Book Group 17		
17	Day 1	He Never Argues - Group 18 (FMN) The Incredible Shrinking Balloon	Helium-filled balloons, Cloth tape measure, Freezer, Timer, Periodic table, Scissors, Glue, Art supplies (markers, colored pencils, crayons)	
	Day 2	Element Book Group 18		
18	Day 1	Putting It All Together (FMN) Make a Molecule Puzzle	Scissors, Glue, Card stock, Gumdrops, Toothpicks, Colored pencils, Large work surface, Sugar, Salt, Flour, Pepper, Peanut butter, Vegteble oil, Clear glass of water, Lettuce, Tomato, Carrot, Salad bowl	
	Day 2	Friendly Gumdrops Mixture or Compound?		
19	Day 1	Molecular Formulas Are Useful (FMN) Molecular Formulas Worksheet	Celery, Glass, Blue food coloring, Water	
	Day 2	The Celery Blues		
20	Day 1	Drawing Lessons (FMN) Drawing Lessons Worksheet	My Periodic Table, Blank paper, Chalkboard or dry erase board, White paper towel, Water, Shallow dishes, Tablespoon, Food color, Vegetable oil, Q-tip, Scissors, Ruler, Tape, Protected work surface	
	Day 2	Capillary Action in Action		
21	Day 1	Matter: An Introduction	My Periodic Table, Colored pencils, Blank paper, Lego pieces	
	Day 2	Matter: An Introduction (continued)		
22	Day 1	The States of Matter (FMN)	Ice, Water, Pot, Heat source, Glass containers, Sealable baggies, Rock, Kitchen scale, Drinking straw (optional)	
	Day 2	Presto-Change-O Water		
23	Day 1	Let's Get to the Point (FMN) What Is the Point?	Crushed ice, Clear glass, Distilled water, Stove, Pot, Science thermometers, Pot Holder, Science encyclopedia or internet access (optional), Jell-O, Cold and hot water, Peanut butter, Mayonnaise, Cups, Spoons, Bowl, Refrigerator, Plate	
	Day 2	State of Confusion		

Week	Day	Lesson / Lab	Supplies Needed For the Week	Dates / Notes
24	Day 1	Solids Are Dense (FMN) Some Are Denser Than Others	Colored pencils, Medium-sized box or container, Stuffed animals, Bathtub or sink filled with water, Orange, Small plastic container, Marbles, Assortment of solids	
	Day 2	The Sinking Tub Boat		
25	Day 1	Molecules Stick Together (FMN)	Sugar, Water, Saucepan, Stove top, Glass jar, Rough string or yarn, Wooden spoon, Metal washer or a Lifesaver candy, Funnel (optional)	
	Day 2	A Big Rock Candy Mountain!		
26	Day 1	What Makes a Liquid a Liquid? (FMN) Liquids Are Dense Too	Corn syrup, Vegetable oil, Water, Clear container, Measuring cup, Food coloring, Chalkboard or sheet of paper, Slime (made in former lab)	
	Day 2	Drawing the States of Matter		
27	Day 1	Friendship of Oxygen & Hydrogen (FMN) Smart Ice	Freezer, Water, Empty plastic soda bottles, Blue food coloring, Blue crayon, Pan, Water, Clear glass tumbler, Insulated copper wire, 9-volt battery, Salt, Spoon	
	Day 2	The Breakup		
28	Day 1	What Makes a Gas a Gas? (FMN) Bubbles	Unopened can of soda, Clear glass, Popping corn, Pan to pop popcorn, Knife, Oil, Heat source for popping corn, Kite, Windy day	
	Day 2	Popping Corn Let's Go Fly a Kite!		
29	Day 1	The Air You Breathe (FMN) Air Takes Up Space	Balloon, Empty 2-liter soda bottle, Glass jar with a lid, Tub or sink full of water	
	Day 2	Why Do Boats Float?		
30	Day 1	Changes (FMN) Physical or Chemical?	Piece of paper, Alka-Seltzer tablet, Water, Match or lighter, Kool-Aid, Sugar, Glass, Container to freeze Kool-Aid, Pitcher, Bubble blowing solution and wand, Cast iron skillet or other fireproof container, Scissors	
	Day 2	Detecting Changes		
31	Day 1	Chemical Reactions Let's Heat Things Up	Legos, Chalkboard or dry erase board, Science or kitchen thermometer, Yeast, Hydrogen peroxide, Clear container, Baking soda, Lemon juice, Spoon	
	Day 2	Let's Cool Things Down		
32	Day 1	Some Like It Sour, Some Don't (FMN) Step 1	Red cabbage, Knife, Distilled water, Strainer, Glass quart jar with a lid, Large container, White coffee filters, Cookie sheet, Bowl, Rubber gloves, Baggie, Vinegar, Ammonia, Lemon juice, Baking soda, Laundry detergent, 7-Up, Salt, Clear plastic disposable cups, Protected work surface	
	Day 2	Step 2		
33	Day 1	Hydrogen & Oxygen & Hydrogen. . .(FMN) Let's Make Water	White vinegar, Baking soda, Cabbage indicator, Indicator paper, Scissors, Small cups, Paint brush, Water, Protected surface	
	Day 2	Painting Magic		
34	Day 1	pHunny pHriends (FMN) Make a pH Scale	Red, blue, and white watercolor or acrylic paint; Paintbrush; Paint pallet; Water; Cabbage indicator paper; Scissors; Knife; Lemon; Grapefruit; Lime; Orange; Cherry tomato; V-8 Juice; Cup; Glue or tape	
	Day 2	pHun with Acids		
35	Day 1	Building Teeth (FMN) Precipitates	Baggie, Chalk, White vinegar, Container with a spout, Plastic wrap, Clear glass container, Bowl, Warm water, Baking soda	
	Day 2	Precipitates (continued)		
36	Day 1	Combustion Action (FMN) Playing with Fire	Glass jars, Roasting pan, Sand, Votive candles, Matches or a lighter, Stopwatch, Dollar bill, Tongs, Salt, Rubbing alcohol, Water, Measuring cup, Sink or other nonflammable surface	
	Day 2	Burning Money		

Reading and Web Site Suggestions

The Usborne Science Encyclopedia is a good general science reference.

Unit 1 – WHAT IS CHEMISTRY?
- *How to Think Like a Scientist* by Stephen P. Kramer
- *I Can Be a Chemist* by Paul Sipiere
- *What Is a Scientist?* by Barbara Lehn

Unit 2 – STARTING SMALL
- *Atoms* (Simply Science) by Melissa Stewart
- *What Are Atoms?* (Rookie Read-About Science) by Lisa Trumbauer – less advanced
- *What's Smaller Than a Pygmy Shrew?* by Robert E. Wells
- *Can You Count to a Googol?* By Robert E. Wells

Unit 3 – THE CHEMIST'S ALPHABET DEFINED
- *The Periodic Table* (True Books) by Salvatore Tocci
- *What is Mass?* by Don L. Curry
- *Grab a Seat At the Periodic Table!: A Chemical Mystery* by Laura Layton Strom
- *The Periodic Table of Elements* (Reading Essentials in Science) by Jenny Karpelenia
- *Sorting the Elements: The Periodic Table At Work* (Let's Explore Science) by Andrew Solway

Unit 4 – THE CHEMIST'S ALPHABET APPLIED
- *Hydrogen and the Noble Gases* by Salvatore Tocci
- *Calcium and the Alkaline Earth Metals* by Nigel Saunders
- *Neon and the Noble Gases* by Nigel Saunders
- *Carbon and Group 14 Elements* by Nigel Saunders
- *Sodium and the Alkali Metals* by Nigel Saunders
- *Oxygen and the Group 16 Elements* by Nigel Saunders
- *Carbon* by Salvatore Tocci
- *C is for Carbon* by Marilee Summers
- *Nitrogen* by Salvatore Tocci
- *Oxygen* by Salvatore Tocci
- *Sodium* by Salvatore Tocci
- *Aluminum* by Salvatore Tocci
- *Silicon* by Salvatore Tocci
- *Chlorine* by Salvatore Tocci
- *Nitrogen and Group 15 Elements* by Nigel Saunders
- *Fluorine and the Halogens* by Nigel Saunders

Unit 5 – MOLECULES RULE
- *Atoms, Molecules, and Quarks* by Melvin Berger

Unit 6 – WHAT'S THE MATTER?
- *What Is the World Made Of? All About Solids, Liquids, and Gases* by Kathleen Weidner Zoehfeld and Paul Meisel
- *What Is Matter?* by Don L. Curry
- *What Is Volume?* by Lisa Trumbauer
- *What Is Density?* by Joanne Barkan
- *Everything Is Matter!* by David Bauer and David Lewis
- *Matter: Solids, Liquids, and Gases* by Mir Tamim Ansary
- *Will It Float or Sink?* by Melissa Stewart
- *Matter: See It, Touch It, Taste It, Smell It* by Darlene R. Stille and Sheree Boyd

What's the Matter in Mr. Whiskers' Room? by Michael Elsohn Ross and Paul Meisel
Solids, Liquids, and Gases by Ginger Garrett
Change It!: Solids, Liquids, Gases and You by Adrienne Mason and Claudia Dávila
Freezing and Melting by Robin Nelson
Air Is All Around You by Franklyn Mansfield Branley and Holly Keller
A Drop Of Water by Walter Wick
Ask Magazine, April 2007, "The Wonder of Water"
KIDS Discover Magazine, May 2007, "Water"
I Get Wet by Vicki Cobb

Unit 7 – REACTIONS IN ACTION
Acids and Bases by Carol Baldwin

WEB SITES: Web site suggestions are given with caution. With the ever-changing nature of the Web, we cannot guarantee the availability or appropriateness of the following sites. Some sites (especially YouTube) may contain inappropriate viewer comments and/or advertising.

Good general sites for information about chemistry:
www.chemistry.about.com

www.chem4kids.com

Many of the fabulous "Bill Nye - The Science Guy" episodes can be viewed on YouTube.
Bill Nye on atoms and molecules:
www.youtube.com/watch?v=PNjKVe7cC0Q

www.youtube.com/watch?v=DtBm4MkpiJc&feature=related

www.youtube.com/watch?v=QEMQLjbJ5bo&feature=related

Bill Nye on chemical reactions:
www.youtube.com/watch?v=_KGtLz081el&feature=related

www.youtube.com/watch?v=rY2hSp1n6mA&feature=related

www.youtube.com/watch?v=7TjxChL0SMA&feature=related

The periodic table and elements:
www.chem4kids.com/files/elem_intro.html

www.eia.doe.gov/kids/energyfacts/science/periodictable.html

Observe what happens when pure sodium and potassium metal are dropped into water (We Are Family lab):
www.science.tv/watch/abcb736ab9a754ffb617/Reactions-of-Sodium-and-Potassium-with-Water

www.teachertube.com/view_video.php?viewkey=d16c49462fb3c951b3eb

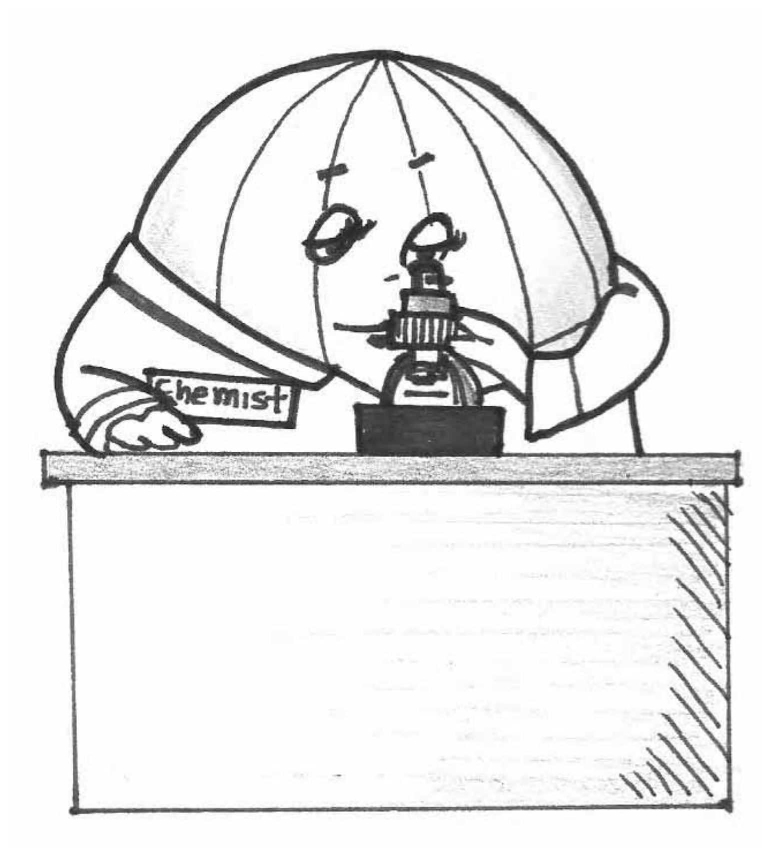
The three states of matter:
http://ksnn.larc.nasa.gov/k2/s_statesMatter_v.html

www.idahoptv.org/dialogue4kids/season7/matter/facts.cfm

Rock changing from a solid to a liquid (What Is the Point? lab):
www.volcanovideo.com/p8vidclp.htm

www.learner.org/interactives/volcanoes/meltrock.html

Unit 1
What Is Chemistry?

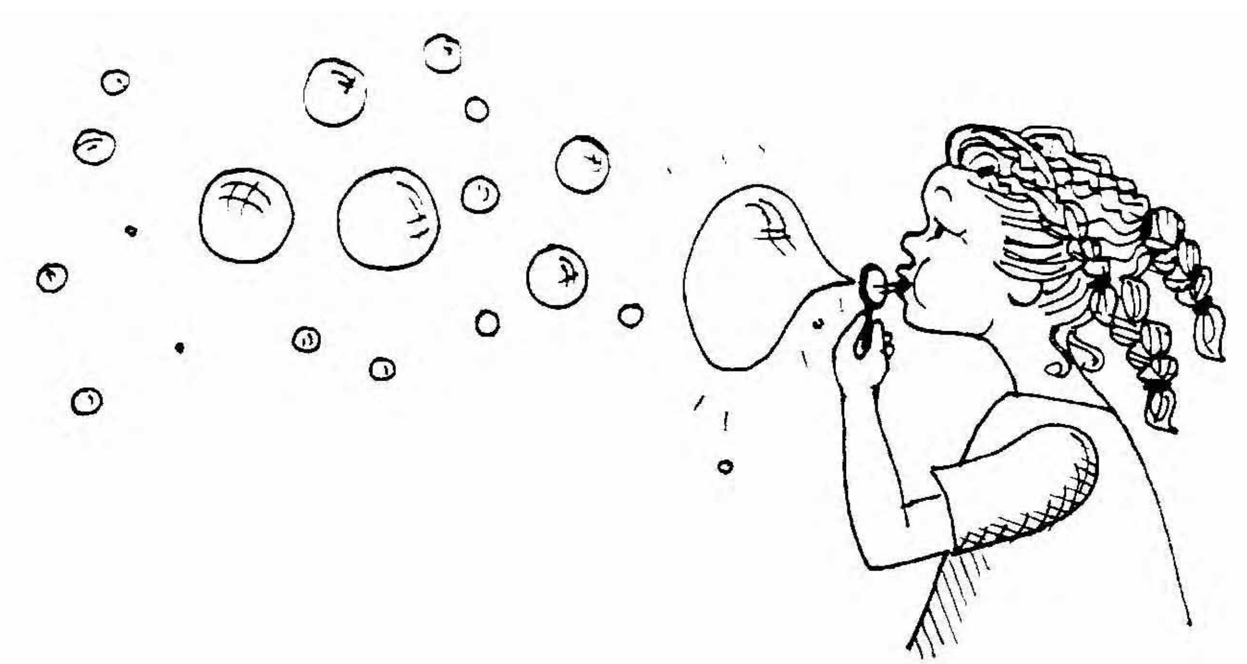


I Am a Chemist

It started with an atom
To this I must confess.
Then it was a molecule
With not one atom less.

Some kids they build with Legos
And some with Playmobile.
But me
Oh, I like atoms
I build things that are real.

I may be only eight
But I already know my fate.
It has been addressed
Yes, I am a chemist.



NAME ______________________________ DATE ___________________

For my notebook

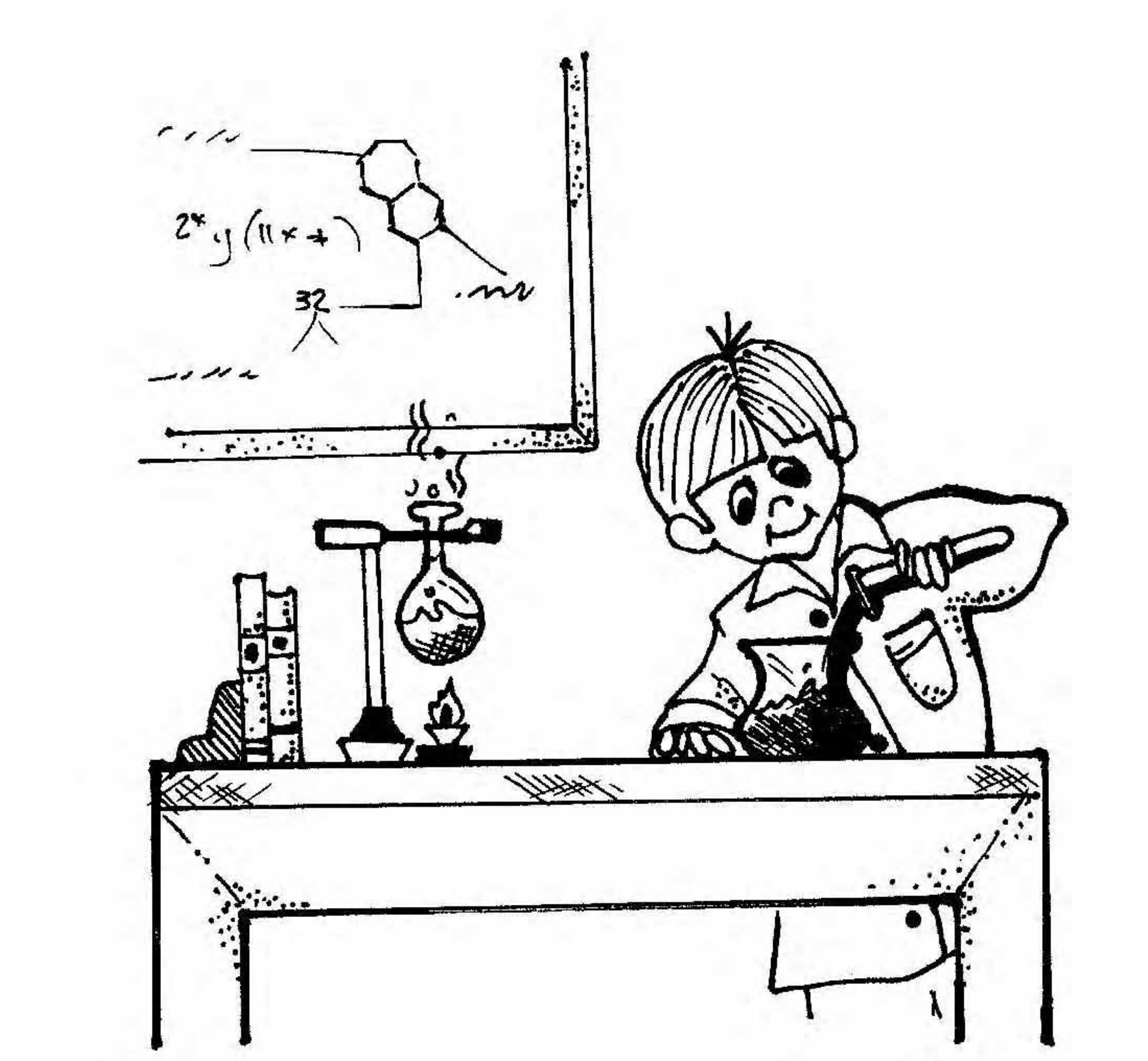
WHAT IS CHEMISTRY?

Have you ever heard grown-ups talking about chemicals in the food you eat, the water you drink, or in the air you breathe? Can I tell you a secret? Everything around you that you can see, and even the things you cannot see, are chemicals. Everything in food is a chemical. Water, itself, is a chemical. The air we breathe is made up of chemicals. If your sister has blue eyes and you have brown eyes, it is because of chemicals. This book is made of chemicals. When grown-ups talk about chemicals, they are usually talking about chemicals that are bad for you. Most chemicals, though, are either good for you or won't hurt you at all. Okay, maybe if you drop this book on your foot it would hurt, but you get my point.

Chemistry is the science that studies chemicals. Since everything is made of chemicals, the science of chemistry interrelates with all other types of science. When you study why a plant grows or how your five senses work in life science, you are also studying chemistry. When you study volcanoes erupting in earth science or how the planets are different from one another, you are studying chemistry. Why a rainbow forms and makes colors, or why some things float and some things sink, is physics and chemistry too. Medical science is as much chemistry as it is biology. You have probably been studying chemistry for a long time and didn't know it!

A chemist is a person who studies how chemicals interact. Chemists ask questions like: Why do lemons taste sour and smell lemony? How do plants die in the winter and come back in the spring? How can a group of chemicals come together

and make a cat? Why do volcanoes erupt? What are stars made of? Why do some people have blue eyes? Why are blue and green next to each other in a rainbow? What kinds of medicine will best help kids when they catch colds? There are so many questions. This year you are going to ask and answer a lot of questions, because this year you are going to be a chemist.



What Is Chemistry? Lab #1: BE A CHEMICAL DETECTIVE – instructions

Materials:
- *Lab sheet, pencil*
- *Box of cereal that has several ingredients*

<u>Aloud</u>: Today you will be a chemical detective. You will be looking for chemicals in common, everyday things. That shouldn't be very hard since everything around you is made of chemicals.

Procedure:
1. In a home situation: Have students go through the house with the lab sheet and a pencil. They will look at a box of cereal and read the list of ingredients. Then they will search items in the rest of the house, looking for chemicals listed on labels. Good places to look include your laundry room, bathroom, garage, and pantry.
2. In a classroom situation: You will need to make sure you have cereal boxes and several other items with chemicals on hand.

Instructor's Notes:
- *The list of ingredients on boxes of your food items are a good place to look for many of the chemicals.*
- *Cleaning fluids are a good place to look for dangerous chemicals. Bleach, ammonia, toilet bowl cleaner, and lighter fluid are dangerous.*

Possible Answers:

Cereal box:
I have heard of these – rice, granola bar pieces, sugar, salt, oats
I have never heard of – red dye #50, annatto, apple puree concentrate

Around your house or school:
Four chemicals you have never heard of – smoke flavor, sodium benzoate, sodium pyrophosphate, sodium stearoyl lactylate
Four things made of chemicals I use everyday – air, water, toilet paper, your brain
Two chemicals that are dangerous – bleach and lighter fluid
A chemical that makes your car go – gasoline
Your favorite chemicals to drink – apple juice
Your favorite chemicals to eat – coconut
Two things that are bigger than a microwave made from lots of chemicals – refrigerator, television, my mom (more than two, but all are good answers)
Two things smaller than a toaster made from lots of chemicals – knife and a mouse
If you were a chemist, what question would you try to answer? – ("What are black holes made of?")

NAME ______________________________ DATE ________________

What Is Chemistry? Lab #1: BE A CHEMICAL DETECTIVE

Chemicals in a box of cereal

I have heard of these:	I have never heard of these:

Around your house or classroom

Four chemicals I have never heard of:

1.	2.
3.	4.

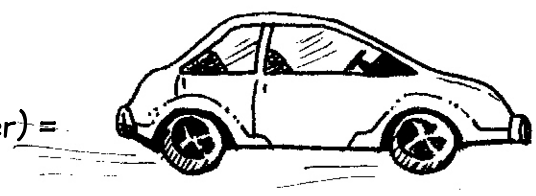
Four things made of chemicals I use everyday:

1.	2.
3.	4.

List two chemicals that are dangerous:

1.	2.

A chemical that makes your car go =



Your favorite chemicals to drink (hint: mine is water) =

Your favorite chemicals to eat (hint: mine is chocolate) =

Two things bigger than a microwave that are made from lots of chemicals:

1.	2.

Two things smaller than a toaster that are made from lots of chemicals:

1.	2.

Bonus: If you were a chemist, what question would you try to answer?

What Is Chemistry? Lab #2: TELLING THINGS APART - instructions

Materials:

- *Lab sheets (two pages), pencil*
- *½ cup Confectionery sugar*
- *½ cup Baking powder*
- *½ cup Baby powder*
- *¾ cup Water*
- *¾ cup Vinegar*
- *¾ cup Cooking oil – any type*
- *Blue food coloring*
- *Three teaspoons*
- *Container to pour liquids from*
- *Three clear glasses*
- *Three dishes to hold confectionery sugar, baking powder, and baby powder*
- *Kitchen towel to clean as you go along*
- *Sink*
- *Dish soap*

Aloud: Sometimes things look the same even though they are different. That can make it hard to tell them apart. When chemists want to know if one thing is different from another, they use two main types of tests. The first type of testing is physical. In physical tests, observations are made about the physical properties of things. Physical properties are how things look, smell, taste, and feel. A chemist would not taste things if she did not know what they were, though, because she would not know if they were dangerous.

The second type of testing is chemical. With chemical tests, a chemist performs experiments on things to see how they behave chemically. She will look at things to see what happens when she puts them in water, in oil, or in an acid, such as vinegar.

In this experiment, you will learn how you can tell different things apart using physical tests and chemical tests. You will take three similar-looking powders and examine them. You will run a series of physical and chemical tests on baby powder, confectionery sugar, and baking powder. Your goal is to observe the physical differences between these three powders and to observe the different ways that these three things behave when you perform chemical tests on them. You begin this lab, as you do most of the labs in this book, by writing a hypothesis for the lab. A hypothesis is your best guess about the outcome of the lab based on what you have learned so far.

Procedure:

1. *Complete the hypothesis portion of the lab report.*
2. *Get out all the materials. The liquids do not need to be measured out at this time.*

Physical Tests:

3. *Measure about ½ cup each of confectionery sugar, baking powder, and baby powder into separate dishes.*
4. *Have students look at each of the powders and note the differences they observe using the physical tests of sight, touch, and smell on the lab sheet. When smelling these, be careful not to breathe in or out too hard.*

Chemical Tests:

5. *Use a different spoon for each powder. Measure a leveled spoon of each powder into a separate glass.*
6. *Add about 1/8 cup of water to each powder. Stir them with a clean spoon and record observations on the lab sheet.*
7. *Clean out the glasses and dry them.*
8. *Measure a leveled spoon of each powder into separate glasses.*
9. *Add about 1/8 cup of vinegar to each. Stir them with a clean spoon and record observations on the lab sheet.*
10. *Clean out the glasses and dry them.*
11. *Measure a leveled spoon of each powder into separate glasses.*
12. *Add 3 drops of food coloring to each glass.*

(continued on the back)

13. Add about 1/8 cup of water to each. Stir them with a clean spoon and record observations on the lab sheet.
14. Add about 1/8 cup of vinegar to each of the glasses. The baking powder mixture might fizz out of the glass.
15. Do they behave differently than they did with only one of the liquids? Record observations on the lab sheet.
16. Clean out the glasses and dry them.
17. Measure a leveled spoon of each powder into separate glasses.
18. Add about 1/8 cup of oil to each. Stir them with a clean spoon and record observations on the lab sheet.
19. Add about 1/8 cup of vinegar to each glass. Wait a minute or so for this part to see what happens. Do not stir. Record observations on the lab sheet.
20. Add 3 drops of food coloring to each glass. Stir them with a clean spoon and record observations on the lab sheet.
21. Raise the glasses to look at the bottoms.

Instructor's Notes:

- I have given specific measurements for the amounts of ingredients, but that is only to make sure you have enough of everything. These measurements do not need to be very accurate.
- Have students fill out their lab sheets as they go along in the experiment. A lot happens in this experiment.
- Use a clean spoon for each of the powders during the Chemical Tests part of this experiment.
- When you are doing this experiment, it is advised that you pick the glasses up to see what is happening on the bottom of each glass.
- The answers for this experiment are only possible answers. Your students will be able to tell the three powders apart, but their descriptions of what is happening might be different from mine.
- I have intentionally not gone into the chemistry involved in this experiment. That would confuse the intention of this experiment at this level. My intention was to teach the difference between physical and chemical tests and to demonstrate how a chemist might go about telling different things apart. This experiment emphasizes observation skills and attention to details. These are very important skills for studying science.
- 1/8 cup = 1 ½ tablespoons

Possible Answers/Observations:

Physical Tests

Sight			Smell			Touch		
baby p.	sugar	baking p.	baby p.	sugar	baking p.	baby p.	sugar	baking p.
white	white	white	good	none	none	soft	soft	grainy

Chemical Tests

baby p. + water	sugar + water	baking p. + water
does not dissolve	dissolves	bubbles/fizzes
baby p. + vinegar	**sugar + vinegar**	**baking p. + vinegar**
does not dissolve	dissolves	fizzes a lot
baby p. + food color + water	**sugar + food color + water**	**baking p. + food color + water**
scummy and lumpy	blue/ mixes with food color	bubbly blue
+ vinegar	**+ vinegar**	**+ vinegar**
does not dissolve	dissolves and clear blue	bubbly blue
baby p. + oil	**sugar + oil**	**baking p. + oil**
does not dissolve	does not dissolve	does not dissolve
+ vinegar	**+ vinegar**	**+ vinegar**
oil on top, baby p. does not dissolve	oil on top, sugar dissolves	bubbly and oily
+ food color	**+ food color**	**+ food color**
food color dots in oil	oil on top of blue liquid	blue, bubbly, and oily

NAME ______________________________ DATE ____________________

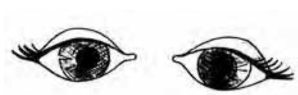
What Is Chemistry? Lab #2: TELLING THINGS APART - page 1

Hypothesis - Write your best guess to the following questions:

1. When I look at the physical properties of confectionery sugar, baby powder, and baking powder, I think I ______________ be able to tell them apart. (will/will not)

2. I think that confectionery sugar, baby powder, and baking powder will be _____________ to tell apart using chemical tests. (easy/hard)

Results/Observations **Physical Tests**

Sight 			Smell 			Touch 		
baby powder	sugar	baking powder	baby powder	sugar	baking powder	baby powder	sugar	baking powder

Chemical Tests

baby powder + water	confectionery sugar + water	baking powder + water
baby powder + vinegar	confectionery sugar + vinegar	baking powder + vinegar
baby powder + food color + water	confectionery sugar + food color + water	baking powder + food color + water
+ vinegar	+ vinegar	+ vinegar
baby powder + oil	confectionery sugar + oil	baking powder + oil
+ vinegar	+ vinegar	+ vinegar
+ food color	+ food color	+ food color

Discussion and Conclusion

Was there something special about each powder that helped you to tell them apart? Circle all the answers that fit for each powder. There are two extra spaces for you to write your own observations.

1. Baby powder

is white smells good is soft

is grainy fizzes mixes with food color

dissolved in water dissolved in vinegar dissolved in oil

does not dissolve in water does not dissolve in food color

does not dissolve in oil ______________ ______________

2. Confectionery sugar

is white smells good is soft

is grainy fizzes mixes with food color

dissolved in water dissolved in vinegar dissolved in oil

does not dissolve in water does not dissolve in food color

does not dissolve in oil ______________ ______________

3. Baking powder

is white smells good is soft

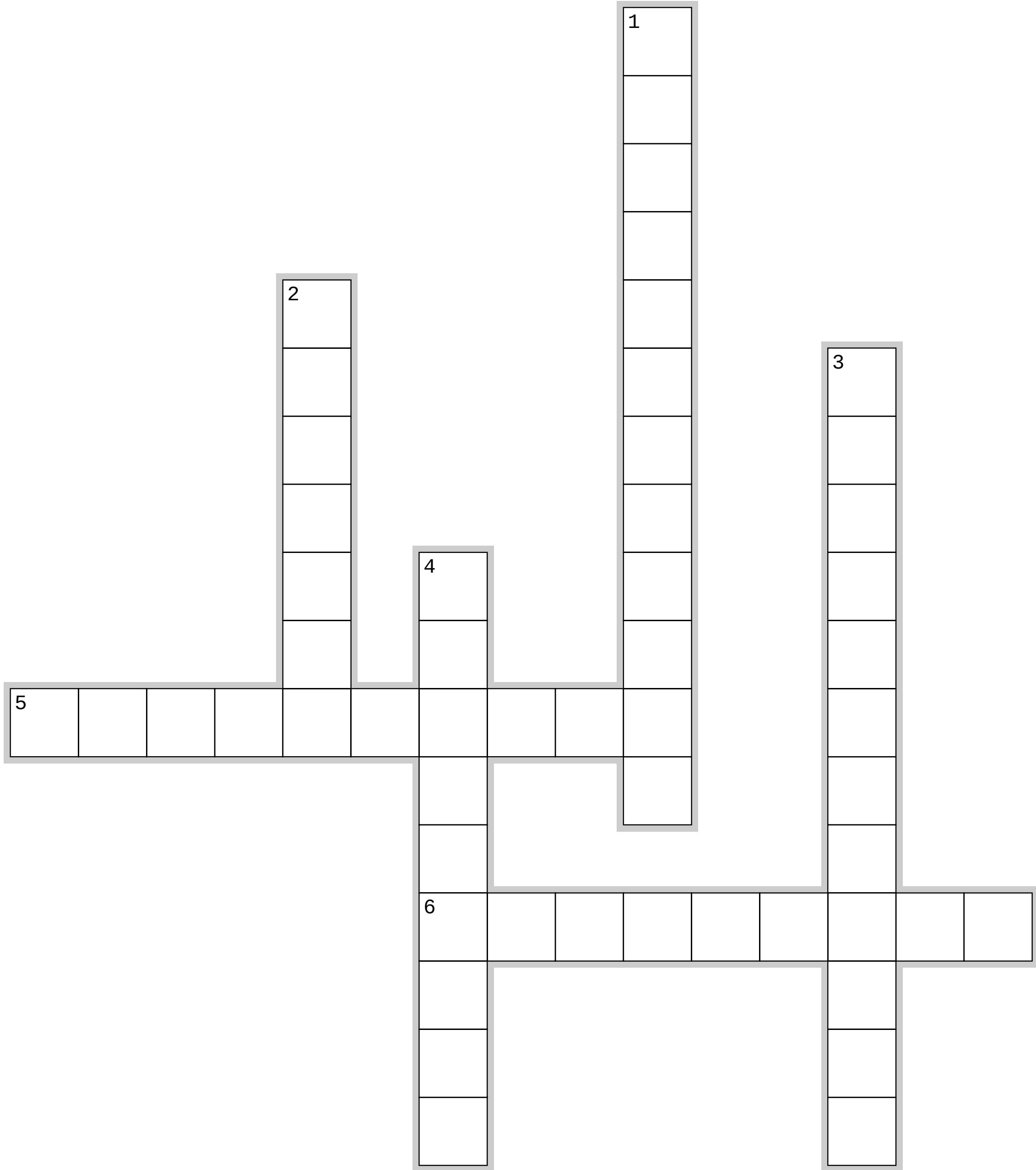
is grainy fizzes mixes with food color

dissolved in water dissolved in vinegar dissolved in oil

does not dissolve in water does not dissolve in food color

does not dissolve in oil ______________ ______________

What Is Chemistry? - Crossword Vocabulary Review



Across

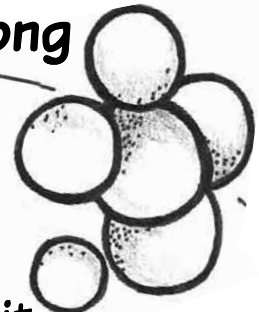
5. An educated guess about the results of an experiment.
6. The science that studies chemicals.

Down

1. A chemist performs this to test how things behave chemically. (Two words)
2. A person who studies how chemicals interact.
3. A chemist performs this to test the physical properties of something. (Two words)
4. Chemists study these.

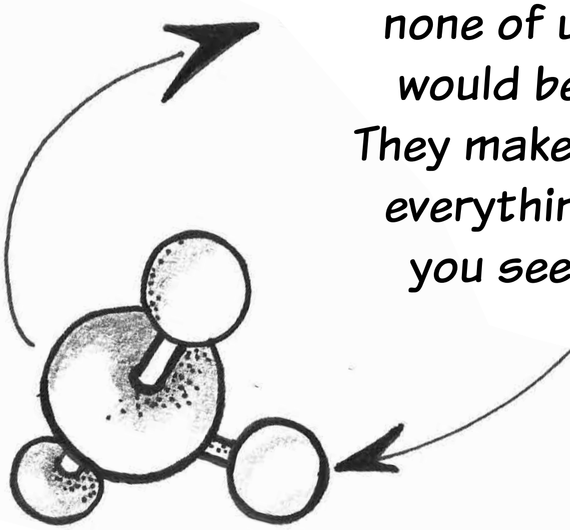
Unit 2
Starting Small

The Atom Song



An atom
is so small
you can't see it,
not at all!

But without atoms
none of us
would be.
They make up
everything
you see.



NAME ______________________________ DATE ___________________

For my notebook

THE ATOM

Have you heard of <u>atoms</u>? Did you know that everything in the world and universe is made of atoms? Atoms are the basic building blocks of everything you see, including yourself. That means even <u>cells</u> are made of atoms. You remember what cells are, don't you? They are the building blocks of living things and atoms are the building blocks of them. Atoms are like the Legos of the universe, only atoms are a lot smaller than Legos. They are so small that a person who weighs 75 pounds would have about 3,500,000,000,000,000,000,000,000,000 (three octillion, five hundred septillion) atoms in his body! Try writing that number down; it's 35 followed by twenty-six zeros.

Thousands of years ago, the ancient Greeks thought a lot about how things are made. About 2,400 years ago, a Greek named <u>Democritus</u> (dih-MOCK-rih-tuss) said that everything was made from particles, called atoms. He thought that all things could be broken down into smaller and smaller pieces until you got to atoms. Democritus also thought atoms moved all the time and that they could join with each other.

The problem with Democritus' <u>theory</u> about atoms was that at that time, there was no scientific way to prove that atoms exist. Atoms are so small that people cannot see them without using a special type of microscope called a <u>scanning-tunneling microscope</u>. There were no scanning-tunneling microscopes 2,400 years ago. Most people living then found it hard to believe in something they could not see. That meant most of the people alive when Democritus was alive did not believe in atoms.

Today we know that Democritus was right. All things are made of atoms. He was right that atoms move all the time. He was also correct that atoms join together. When atoms join, they make <u>molecules</u>.

Move your hands in the air. As you move your hands through the air, you are hitting atoms and molecules. You cannot see them, but they are there. Air is mostly made of two types of atoms whose names are <u>nitrogen</u> and <u>oxygen</u>. Water is made of atoms, too. Water is made of two types of atoms called <u>hydrogen</u> and oxygen. Everything is made of atoms!

The Atom Lab #1: ARE ATOMS Small? - instructions

Materials:

- Lab sheet, pencil
- Five balloons that have <u>not</u> been inflated
- Almond extract
- Water
- Cinnamon
- Lemon, orange, or peppermint extract
- Magnifying glass
- ½ Teaspoon measuring spoon
- Permanent marker

Part 1:

<u>Aloud</u>: Atoms are really small. Think of the smallest thing you have ever seen with your own two eyes. Atoms are a lot smaller than even that. Look at your lab sheet. Do you see the dash under the magnifying glass? How many atoms do you think are in that dash?

Procedure:

Have students trace over the dash on the lab sheet with a pencil, and examine it with a magnifying glass. Wait for students to write a guess about the number of atoms.

<u>Aloud</u>: There are 40,000,000 (40 million) atoms in that dash! Atoms are small, but everything is made of them. The next time you go outside, look at all the different things in the world that are made of atoms. If it is a sunny day, remember even the sun is made of atoms. If it is rainy or cloudy, remember the clouds and the raindrops are all made of atoms. Oh, by the way, a raindrop has about 5,000,000,000,000,000,000,000 (5 sextillion) atoms in it. If you catch one on your tongue, think about that! Do you remember what kind of atoms are in raindrops? There are hydrogen atoms and oxygen atom in raindrops because raindrops are made of water.

Instructor's Notes:

- The dash is 2mm long. There are about 20 million carbon (graphite) atoms in a pencil dash that is 1 mm.

Part 2:

<u>Aloud</u>: What does the outside of a balloon smell like? Would you say sort of rubbery or like nothing at all? What if you put something with a strong scent or smell into a balloon? Would you be able to smell what's in the balloon if you inflated it? How could you? Maybe you could put a small hole in it. The problem with that is, if a balloon had a hole, it wouldn't hold air, would it?

Today, you are going to smell five balloons. Each balloon has something different in it. You will see if you can smell the scent atoms through the balloons.

Balloons are made of atoms like everything else in the world. The things you will be putting into the balloons are made of atoms too. Do you think the scent atoms will be small enough to go through the atoms of the balloon?

Procedure (read over the entire procedure before starting the lab):

1. Complete the hypothesis portion of the lab sheet.
2. Before inflating the balloons, have students examine them. They should smell them and check them for holes with a magnifying glass. If they find a hole in a balloon, discard it and get another with no holes. Blow one of the balloons up and have the students examine this balloon with the magnifying glass. They are checking it for holes.

(continued on the back)

3. ***Do this next step before inflating the rest of the balloons and out of sight of your students.*** *Pour water, cinnamon, almond extract, and the other type of extract in four different balloons. After each addition, blow the balloon up and tie off tightly. Do not over-inflate the balloons. If you do, they could pop and you will have a mess. Be careful not to get anything on the outside of the balloons or your hands. If you do get something on the balloon, wash it off with soap and let it dry. Label the balloons "1," "2," "3," and "4," or you can use different-colored balloons for identification. The students will guess what is in them. The rest of the experiment is done in front of the students. Shake each balloon for 30 seconds starting with the balloon that has only air in it. Have students smell the outside of the balloon. Have them record results on the lab sheet.*

Instructor's Notes:

- *If you use peppermint extract, put it at the end of the experiment. It smells so strong that it can affect how the unscented balloons smell. You might want to leave it in another room until all the other balloons have been tested.*
- *Cinnamon and vanilla extract can be seen through light-colored balloons. Try using a dark-colored balloon for these scents.*

Possible Answers:

Results / Observations

Before being inflated, the balloons should smell like nothing, or rubbery, or like a balloon.
Before and after the balloons are inflated, students should not see any holes in the balloons.

Data Table

Students should fill in the part of the data table where they guess what the balloons have in them. You should help them fill in the part that tells what was really in the balloons.

They should smell both extracts and cinnamon. They should not smell anything from the balloon with air in it and the balloon with water in it. They might correctly guess the balloon with water because they will be able to hear that it has liquid in it.

Discussion/Conclusion

They should have smelled all three things that had a scent.
From this, students should have learned that the scent molecules and atoms are small enough to travel between the atoms that make up the balloon.

NAME ______________________________ DATE ____________________

The Atom Lab #1: ARE ATOMS Small?

Part 1:

–

I think there are _________________________________ atoms in that dash.

Part 2: Hypothesis (circle your answer):

I think scent molecules are small enough to travel through the molecules of the balloons and that I will smell the scents put in the balloons.

Yes **No** **I don't know**

I think the balloons with air and water will smell the same as they did before being inflated.

Yes **No** **I don't know**

Results / Observations:

Before being blown up, my balloons smelled like ______________________

When I looked at the balloon with my magnifying glass, I saw:

Before being blown up ______________________________________

After being blown up _______________________________________

Data Table	The balloon smelled like	What was in the balloon?
balloon filled with air		air
balloon #1		
balloon #2		
balloon #3		
balloon #4		

Discussion and Conclusion:

Did you smell any of the things put into the balloons?__________

Which ones did you smell?________________________________

What did the scents teach you about the size of atoms and molecules?

The Atom Lab #2: DO ATOMS *MOVE*? – instructions

CAUTION: THIS LAB INVOLVES HANDLING VERY HOT WATER. ONLY THE PARENT/INSTRUCTOR SHOULD HANDLE THE HOT WATER.

Materials:

- Lab sheet, pencil
- Color pencil or crayon (same color as the food coloring)
- 3 cups of Water at three different temperatures:
  1) Chilled (Put ice and water into a container and drain off the water for use.)
  2) Room temperature
  3) Very hot (just been boiled)
- Food coloring (Use the same color and amount for each test. A darker color is better.)
- Three clear glasses, the same size
- Thermometer, science or kitchen-type
- Stopwatch or a timer that counts in seconds

<u>Aloud</u>: When you look at a drop of water, can you tell that the hydrogen and oxygen atoms in it are moving? Well, they are moving, and very fast too. In this lab, you are going to drop food coloring into water. You will not see a single food color atom move through the water; atoms are too small to see by themselves. But you can see a group of food color atoms move through the water. When you put the drops in the water, the food coloring will mix with the water without you stirring it. When things mix without being stirred, it is called <u>diffusion</u>. Temperature can affect how fast atoms and molecules mix with each other. The water in each glass will be a different temperature. Do you think the molecules will diffuse faster in the hot water or the cold water?

Procedure:

1. Complete the hypothesis portion of the lab sheet.
2. Measure one cup of each temperature of water into three clear glasses.
3. Right away, measure the temperature of each glass of water. Do this very carefully so you don't stir the water. (To prevent the thermometer from shattering, allow it to cool for a few seconds between the hot and cold water.) When the thermometer stops moving up or down, record the temperatures on the lab sheet.
4. Carefully drop 5 drops of food coloring into each glass of water.
5. Immediately observe what happens in each glass and record observations on the lab sheet. Observations should be recorded in words and pictures.
6. Wait 2 minutes. Measure the three temperatures again. Record observations on the lab sheet.
7. Wait 30 minutes. Measure the three temperatures again. Have there been any changes?
8. Complete the lab report.

<u>Aloud</u>: When you can see things diffuse, you are watching molecules and atoms in motion. Heat can make atoms and molecules move faster. You used colored molecules in this experiment so it would be easy to see them move through the colorless water. But atoms are moving all the time, even when you can't see them.

Instructor's Notes:

- Make sure each glass has the same amount of water. If you use more or less than a cup of water the rate of diffusion will be affected.
- Make the sure the water is not stirred, or otherwise moving, when you carefully drop in the food coloring. You want the atoms to mix through diffusion, not from stirring.
- When food coloring is put in the hot water, it diffuses very quickly. Make sure students are watching the experiment right from the start.
- Thirty minutes might not be enough time for the food color to diffuse completely through the water in the room temperature and cold water. Try leaving the glasses sitting out until the color diffuses completely.

(continued on the back)

Possible Answers:

Hypothesis:

The correct answers are yes, yes, hot.

Results:

Data Table

The temperatures will vary.

Observations:

Each square represents a glass of water with food coloring in it. The coloring in each square should look similar to the diffusion pattern in each glass of water + food coloring at the specified time.

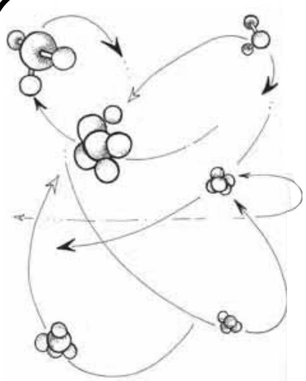
Conclusion:

The atoms diffused fastest in hot water.

The atoms diffused slowest in cold water.

NAME ______________________________ DATE ____________________

The Atom Lab #2: DO ATOMS *MOVE*?



Hypothesis:

Do you think you will see the food color atoms diffuse (move) through the water?

Yes No I don't know

Do you think the temperature of the water affects the rate of diffusion (how fast things move) in the water?

Yes No I don't know

I think atoms move faster when they are _____________.

cold room temperature hot

Results:

Temperature:	Chilled water	Room temperature water	Hot water
Start			
2 minutes			
30 minutes			

Observations: *Color the squares to show what is happening to the food coloring in each glass of water.*

Chilled water			Room temperature water			Hot water		
Start	2 min	30 min	Start	2 min	30 min	Start	2 min	30 min

Conclusion: *Circle the correct word(s) to complete each sentence.*

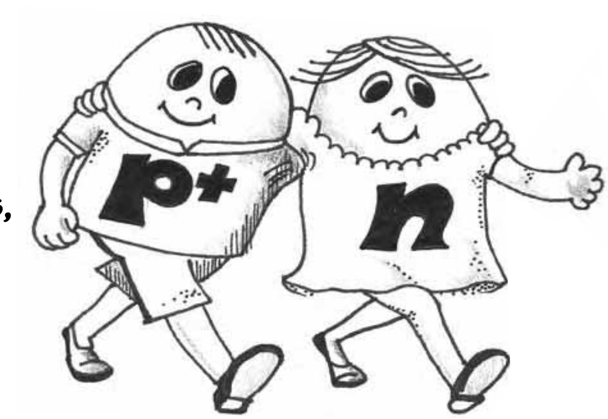
The atoms diffused fastest in cold room temperature hot water.

The atoms diffused slowest in cold room temperature hot water.

What's in an Atom?

So what's in an atom?
Let's start
And learn
Each part.

Proton,
Electron,
Neutron,
Yeah.



Inside the nucleus,
There are two kinds of things,
The neutral neutron
And the positive proton.
They're good friends,
Like you and me.
They don't like to be seen separately.

Proton,
Electron,
Neutron,
Yeah!

Then there's a little guy
Orbiting around.
He's really fast
But he doesn't make a sound.
He's the electron
And he's negatively charged.
He's really small.
He's not at all large.

Proton,
Electron,
Neutron,
Yeah!!

Proton,
Electron,
Neutron,
Yeah!!!

Proton,
Electron,
Neutron,
Yeah!!!!

PARTS!

Materials:

- *"Parts of an Atom" poster, 1 per student*
- *Crayons or colored pencils – purple, red, blue, green, and orange*
- *Construction Paper – one 8 ½ " x 11" piece*
- *Glue*
- *"What's in an Atom?" poem (p. 44)*

Hand out the "Parts of the Atom" poster found page 47. Students should follow along on it while you read below.

Aloud: *The picture on the poster shows the parts of an atom. Atoms are very small, but there is something even smaller than atoms. Atoms are made of three main parts, and the parts that make up atoms are smaller than atoms. These three parts are called protons (PROH-tonz), neutrons (NOO-tronz), and electrons (ee-LEK-tronz).*

Let's learn what an atom looks like. I am going to read a description of the parts of an atom to you. I want you to follow along on your Parts of an Atom poster using your crayons.

Look in the center of the atom. Do you see the four circles in the center of the atom? This center part of an atom has a special name. It is called the nucleus (NOO-klee-uhss). With a purple crayon, draw one tight circle around all four circles in the nucleus. Can you find the word "nucleus" in the word box? Shade the word "nucleus" purple. The nucleus is made of things called protons and neutrons.

Find the two neutrons by looking for the letter "n" inside two of the circles in the nucleus. Color the neutrons blue. Look at the neutrons. They look the same as each other. That is because all neutrons are the same as each other. Find the word "neutron" in the word box. Shade the word "neutron" blue.

The two protons in the nucleus have a "p+" inside their circles. Color the protons red. Look at the protons. They look the same as each other. That is because all protons are the same as each other. Find the word "proton" in the word box. Shade the word "proton" red.

An electron is a small particle that orbits around the nucleus. There are two of them; they have an "e-" in their circles. Can you find both of them? Color them green. Look at the electrons. They look the same as each other. That is because all electrons are the same as each other. Shade the word "electron" green.

The energy level is where you find the electrons of an atom. Trace over the energy level, the big circle the electrons are in, with an orange crayon. Shade the words "energy level" at the top of the page orange.

Now there is one last part of your atom I want you to notice. Well, it's actually not a part, but rather the lack of a part. Let me explain. Do you notice what is between the nucleus where the protons and neutrons are and the energy level where the electrons are? Nothing! Atoms have a whole lot of empty space in them. In fact, empty space is the biggest "part" of an atom.

Cut out your Parts of an Atom poster and glue it onto a piece of construction paper. Hang it on your wall to help you remember the parts of the atom while you study chemistry this year.

The atom you just colored is a helium (HEE-lee-em) atom. It is a special type of atom. Helium is used in balloons to make them float. It is also what they put in blimps to make them lighter than air.

(continued on the back)

Instructor's Notes:

- *The Parts of The Atom poster created today is used as a reference by students throughout this book.*
- *Recite the "What's in an Atom?" poem to help students remember the parts of an atom.*
- *Throughout this course I will be referring to electrons being on energy levels as they circle the nucleus in an atom. Traditionally these circles were called "orbits" but recent atomic discoveries have led to the more accurate term "energy level." Whether energy level or orbit, when teaching about atoms we draw models with electrons neatly circling the nucleus. But the fact is, the placement of electrons is more accurately described as a cloud, and the location of electrons in a cloud is determined by a probability function. For this age-group, however, this concept is best taught as tidy energy levels.*

For More Lab Fun:

If you have a group of three or more students, try acting out an atom while reciting the "What's in an Atom?" poem. Have students play the parts of the "proton" and the "neutron" standing very close together in the center, and the "electron" orbiting around them in the "energy level." Clap and shout the chorus.

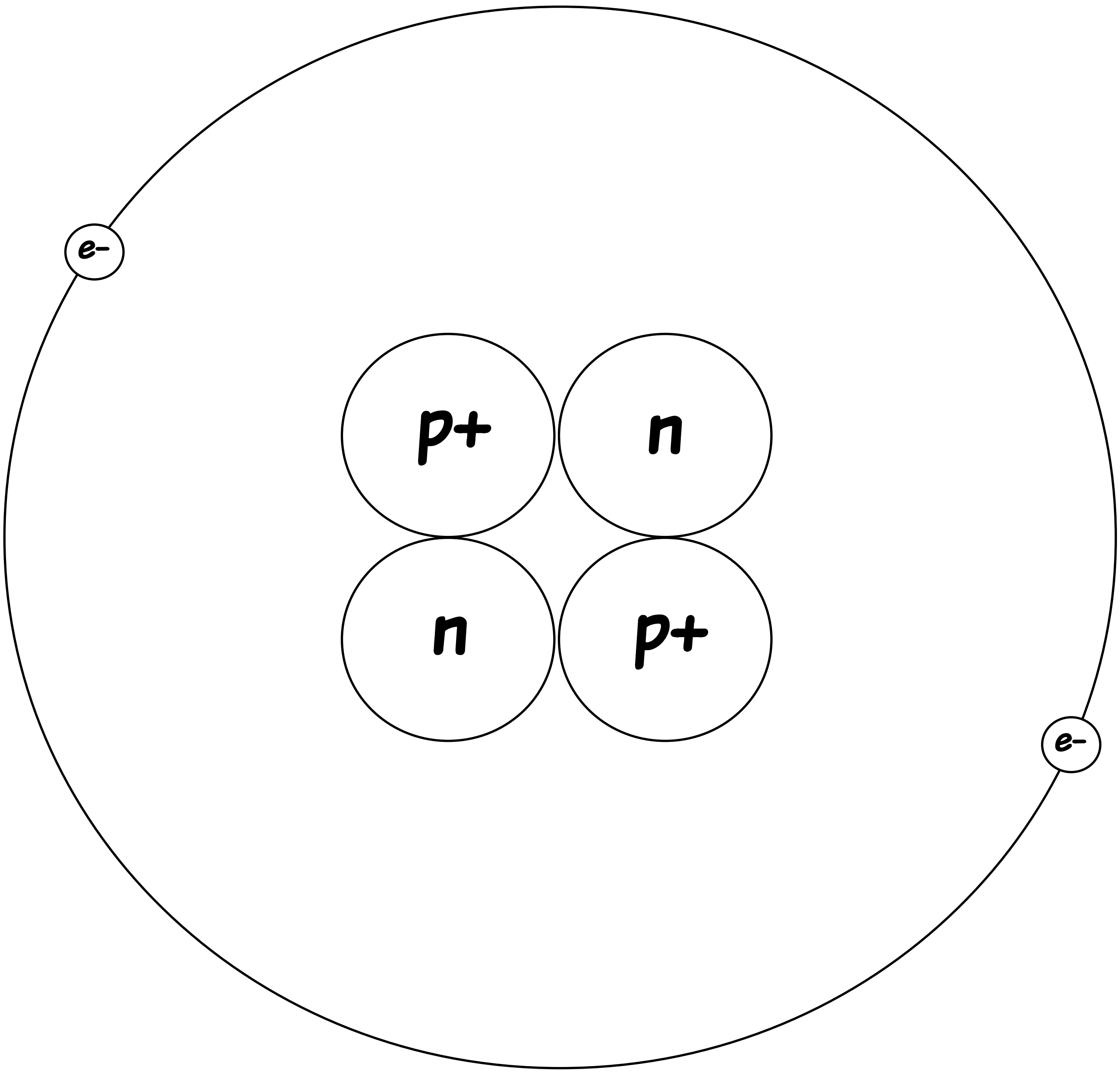
Recite "What's in an Atom?" at the start of each science class for the next few weeks until students know the parts of an atom well. Then review the poem periodically throughout the school year.

NAME ______________________________ DATE ____________________

PARTS OF AN ATOM

nucleus	proton (p+)	neutron (n)

electron (e-)	energy level



Helium (He)

Parts! Lab: LET'S BE POSITIVE – instructions

Materials:
- *Copy of lab sheet, pencil*
- *Inflated balloon*
- *Wall*
- *Mirror*
- *Carpet or sofa covered in cloth material (leather sofas won't work)*
- *Completed "Parts of an Atom" poster*

Aloud: Have you ever gotten a shock when you touched something or someone? Have you taken something out of the dryer and had it cling to you? These things happen when enough electric charge builds up and moves from one thing to another.

Are you thinking, "Hey, wait a minute! Isn't charge what horses do at the start of a battle?" Maybe you are thinking, "Isn't charging what my mom does when she goes shopping?" You can see both of those types of charge. You can see the other type of charge too.

The electrons orbit around the outside of the atom and sometimes you can rub them off onto something else. A charge can be either positive or negative. Do you notice the protons have "+" signs and the electrons have "-" signs in the atom on the "Parts of an Atom" poster? Protons have positive charge and electrons have negative charge. That is why there are "+" signs in the protons and "-" signs in the electrons.

When you rub a balloon on carpet or a sofa, electrons will rub off them and on the balloon. The balloon will have a negative charge from the electrons because of this. The positive part of your hair and the wall will be attracted to the negatively charged balloon. Opposites really do attract!

Procedure:
1. *Before rubbing the balloon on anything, put the balloon next to a student's hair and the wall. Have students record their observations on the lab sheet.*
2. *Rub the balloon ONLY in one direction on your carpet or sofa. Rub it five to ten times. Be careful not to pop the balloon.*
3. *After rubbing the balloon, hold it next to a student's hair and let him look in a mirror. After that, touch the balloon to a wall. Have students record their observations on the lab sheet.*

Aloud: When the balloon is rubbed on the sofa/carpet, electrons rub off the sofa/carpet and onto the balloon. The extra electrons on the balloon attract the protons in your hair and on the wall. Try it on more things. If you rub the balloon again, though, make sure you do not rub it in a different direction.

Instructor's Note:
- *If it is humid or rainy where you live, this might not work. Wait for a drier day.*

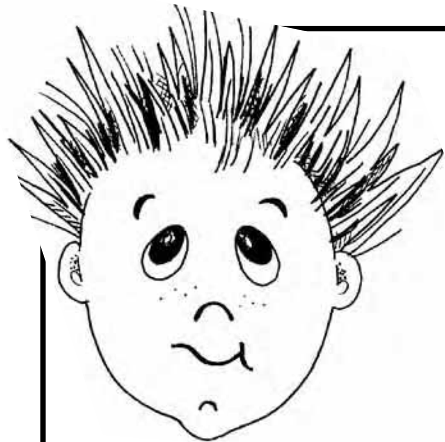
Possible Answers:

Before rubbing the balloon: nothing happened, nothing happened

The pictures should show hair standing up and a balloon sticking to the wall.

NAME ______________________________ DATE ____________________

Parts! Lab: LET'S BE POSITIVE



Before rubbing the balloon on the carpet or sofa, . . .

when I held the balloon close to my hair____________
____
____.

when I held the balloon close to the wall ___________
____
____.

Results:

Draw pictures to show what happened after rubbing the balloon.

When I held the balloon close to my hair, it looked like this:

When I held the balloon close to the wall, it looked like this:

NAME ______________________________ DATE ____________________

For my notebook

Types!

The atom on your "Parts of an Atom" poster is a special type of atom. It is a helium atom. There are over 100 different types of atoms. Isn't that a lot? How could that be if all atoms are made of the same three things—electrons, protons, and neutrons? It is true, though. Just look around you. Isn't it incredible that all the things you can see are made from the same three things?

So, if everything is made up of the same three things—protons, electrons, and neutrons, then what makes one type of atom different from another? Think of a piece of aluminum foil and a pencil lead. Aluminum foil is made of <u>aluminum</u> atoms, and a pencil lead is made of <u>carbon</u> atoms. Remember, an electron in an aluminum atom is exactly the same as an electron in a carbon atom. The protons are all the same as each other in both atoms and so are the neutrons. Aluminum and carbon look so different from each other, it is hard to believe they are made from the same things, isn't it? An atom of aluminum has more protons, neutrons, and electrons than an atom of carbon, and that is all that makes it different. Wow!

Aluminum foil is made of LOTS of aluminum atoms. The tip of the pencil is made of LOTS of carbon atoms. A group of the same type of atoms is called an <u>element</u>. When you look at aluminum foil, you are looking at the element aluminum because there is only one type of atom in the foil (aluminum atoms) and there is more than one of them. The pencil lead is the element carbon because it is made up of only carbon atoms.

Types! Lab: THE FIRST TEN - instructions

Materials:
- Lab sheet, pencil
- Small piece of aluminum foil
- Pencil lead or a sharpened pencil
- One bag of mini marshmallows - all the same color (e.g. white)
- Two bags of regular-size marshmallows, 2 different colors - besides traditional white, Kraft Foods makes chocolate (brown) and strawberry (pink) marshmallows
- Ten blank sheets of paper (8 ½ x 11)
- Large table, counter, or floor space where you can spread out 10 marshmallow atoms (at least 10 feet wide)
- Kitchen scale
- "Parts of an Atom" poster (completed) and "What's in an Atom?" poem
- Scissors
- Atomic Energy Levels Diagram (page 59)
- Periodic table found on the inside back cover of this book

Aloud: Look at the piece of aluminum foil* and the pencil lead*. Remember that the only difference between them is that aluminum atoms have more electrons, protons, and neutrons than the carbon atoms making up the pencil lead. Today you will make ten different types of atoms using marshmallows, and the only difference between them will be the number of protons, electrons, and neutrons. Each different type of atom in the universe has its own name. There are more than 100 and the number keeps growing. That means there are over 100 names for the types of atoms. Today you will make the first 10 types of atoms.

* There are impurities (small amounts of other types of atoms) found in aluminum foil and pencil leads. For the sake of teaching elements, I ignored this fact.

Procedure:
1. Let students examine and compare the aluminum foil and pencil lead.
2. Cut out the name squares of the different types of atoms on the lab sheet. The pronunciation for them is given as each type of atom is introduced. There is a number by each name. The numbers are the atomic numbers and also indicate the order in which you will make the atoms. The name with the number 1 by it, for example, is the atom that is made first.
3. Before beginning to build the atoms, use the "Parts of an Atom" poster that students made last week and "What's in an Atom?" poem to refresh their memories about what an atom looks like.
4. Decide which color of the regular-size marshmallows will be protons and which will be neutrons. The mini marshmallows will be electrons.
5. Students should build each atom on a separate sheet of blank paper as you read the scripted directions found on the next page. Work your way through building the atoms one at a time, beginning with hydrogen and ending with neon, placing the marshmallow protons, neutrons, and electrons in their proper places for each atom. As students make the atoms, have them put the matching atom name label on the sheet and write in the missing number of protons, electrons, and neutrons on the label.

Instructor Notes:
- This lab is in two parts, building the marshmallow atoms and then placing the marshmallow electrons in energy levels. You might choose to do both parts consecutively, in one long lab. If you choose to split this into two days, you have to rebuild the marshmallow atoms for the second day.
- Look at the periodic table found on the inside back cover of this book to assist you with placement of the marshmallow atoms on your work surface. The placement is important because it mimics the periodic table, which students will learn about later in this course.

(continued on the back)

- *The number of neutrons does not increase by a consistent amount. Therefore, you will provide the number of neutrons for the student every time. The number of protons and electrons increases by one, going from one type of atom to the next. You will begin writing the numbers of protons and neutrons for students until a point, noted in the text. After that, you will discuss the pattern and students will help determine the correct number of protons and neutrons to write down.*
- *Many of the names of the atom types (element names) will not be familiar to your students. It is not the purpose of this lab to teach what these elements are. That is done in another unit. The names are given here as a way to distinguish the different types of atoms.*
- *As students build atoms, the number of protons and neutrons will increase. In order to fit all the marshmallows on the paper, you may have to stack the "protons" and "neutrons" on top of each other.*

Aloud Part 1 - Building Atoms:

neutron 0
proton 1
electron 1

1. Let's start making atoms. First is hydrogen (HI-dreh-jen).

- **Put a blank piece of paper on the top *left* side of your work surface. Cut out all of the atom labels found on the lab sheet. Glue or tape the name "hydrogen" onto the top of the paper.**
- **You need one proton for your hydrogen atom. Where should you put it? (nucleus)**
- **Now take one electron and put this orbiting the proton.**
- **You have now made a hydrogen atom. Wait! Did I forget something? Where is the neutron? Guess what? Hydrogen does not have one, it just has a proton and an electron. Neutrons are funny little guys; sometimes they match the number of protons and sometimes they don't. I will tell you how many neutrons you need for each type of atom.**

neutron 2
proton 2
electron 2

2. Helium is #2. (HEE-lee-em)

- **Put another blank piece of paper on the far *right* side of your work surface. Glue or tape the name "helium" onto the top of the paper.**
- **You need two protons and two neutrons for helium. Did you put these in the center of the atom? They make up the nucleus.**
- **Next, you need two electrons orbiting the nucleus.**

neutron 4
proton 3
electron 3

3. Lithium is #3. (LITH-ee-em)

- **Start a second row of atoms by placing a blank piece of paper with the label for lithium below the hydrogen atom.**
- **Lithium has three protons and four neutrons in its nucleus.**
- **All the atoms you are making today have the same number of electrons as protons. How many electrons does lithium have? (3) Write the number of electrons on the label.**

Now I want to teach you something important. Answer these questions for me.
How many protons does hydrogen have? (1) How many electrons does hydrogen have? (1)
How many protons does helium have? (2) How many electrons does helium have? (2)
How many protons does lithium have? (3) How many electrons does lithium have? (3)
Do you see a pattern?
When going from one type of atom to the one that is next in line, you ALWAYS add 1 and ONLY 1 proton and 1 electron. Let's make more atoms and see how this works.

neutron 5
proton 4
electron 4

4. Beryllium is #4. (beh-RIL-ee-em)

- **Place the paper for beryllium to the right of lithium.**
- **If hydrogen has 1 proton, helium has 2 protons, and lithium has 3 protons, how many protons does beryllium have? (4)**

- Make the nucleus for beryllium. It has five neutrons.
- Beryllium has four electrons.
- Write the number of protons and electrons on the label.

neutron 5
proton 5
electron 5

5. Boron is #5. (BO-ron)
- Put a sheet of paper and the label for boron next to beryllium.
- Boron has five neutrons.
- How many protons and electrons does it have? (5)
- Construct a marshmallow boron atom and write the number of protons and electrons on the label.

neutron 6
proton 6
electron 6

6. Carbon is #6. (KAR-ben)
- Put a sheet and the label for carbon next to boron.
- A carbon atom has six neutrons.
- How many protons and electrons does it have? Remember boron had 5. (5+1 = 6)
- Construct a marshmallow carbon atom and write the number of protons and electrons on the label.

Does it seem simple to make one type of atom and then the next? Well, it is. You are using marshmallows to make each type of atom. Every time you make an atom, you use the same kind of marshmallow for the protons and the same kind for the neutrons and the same kind for the electrons. If you could see something as small as a real atom, you would see that all electrons are the same as each other. All protons are the same as each other and all neutrons are the same as each other. What makes one type of atom different from another is the *number* of protons, neutrons, and electrons that it has. Amazing, isn't it?

neutron 7
proton 7
electron 7

7. Nitrogen is #7. (NYE-truh-gen)
- Put a sheet and the label for nitrogen next to carbon.
- Nitrogen has seven neutrons.
- How many protons and electrons does nitrogen have? Carbon had six of each. (7)
- Construct a marshmallow nitrogen atom and write the number of protons and electrons on the label.

neutron 8
proton 8
electron 8

8. Oxygen is #8. (OK-si-jen)
- Put a sheet and the label for oxygen next to nitrogen.
- Oxygen has eight neutrons.
- How many protons and electrons does oxygen have? Nitrogen had seven of each. (8)
- Construct a marshmallow oxygen atom and write the number of protons and electrons on the label.

neutron 10
proton 9
electron 9

9. Fluorine is #9. (FLOOR-een)
- Put a sheet and the label for fluorine next to oxygen.
- Fluorine has ten neutrons.
- How many protons and electrons does fluorine have? (9)
- Construct a marshmallow fluorine atom and write the number of protons and electrons on the label.

(continued on the back)

neutron 10
proton 10
electron 10

10. **Neon is #10. (NEE-on)**

- **Put a sheet and the label for neon next to fluorine.**
- **Neon has 10 neutrons.**
- **How many protons and electrons does neon have? (10)**
- **Construct a marshmallow neon atom and write the number of protons and electrons on the label.**

11. **Move the helium atom in the first row over the top of the neon atom. (There should be a big space between hydrogen and helium.)**

12. **Weigh the marshmallow nucleus (protons and neutrons) of your neon atom on the scale. Now add the electrons for neon to the scale. Did the electrons make much of a difference to the overall weight? Where is almost all of the mass of the marshmallow neon atom? In real atoms (not just in marshmallow ones), almost all the mass is in the nucleus too.**

Now that you are an expert at making the different types of atoms, let's talk about energy levels. Leave the atoms you have made out, you will need them for this next section.

<u>Aloud Part 2 - Energy Levels:</u>

Can you find the energy level for helium on your "Parts of an Atom" poster? Remember, an atom's electrons go in its energy levels. How many electrons are in the energy level of helium on your poster? (2) Most atoms have more than one energy level. The energy levels have very strict rules about how many electrons can fit in each one. Think of it like musical chairs. There are only so many "seats" in each energy level, and each seat fits only one electron. Any more electrons in the atom have to go in the next energy level. The first energy level is the one closest to the nucleus. Only two electrons fit in this energy level. When the "music" stops at the first energy level, there can only be one or two electrons in it. The first energy level is always the first one to fill up.

Show the Energy Level Diagram on the next page to students or draw the diagram on a chalkboard.

Think of the nucleus of an atom as a planet and the electrons as moons. Hydrogen and helium have one energy level. Their electrons are like moons that have the same orbit. The atoms from lithium through neon have two energy levels.

13. **Go back to your atoms. Put the electrons that go in the first energy level in their special "seats" in the energy level closest to the nucleus. Starting with hydrogen and ending with neon, put one to two electrons in the energy level closest to the nucleus.**

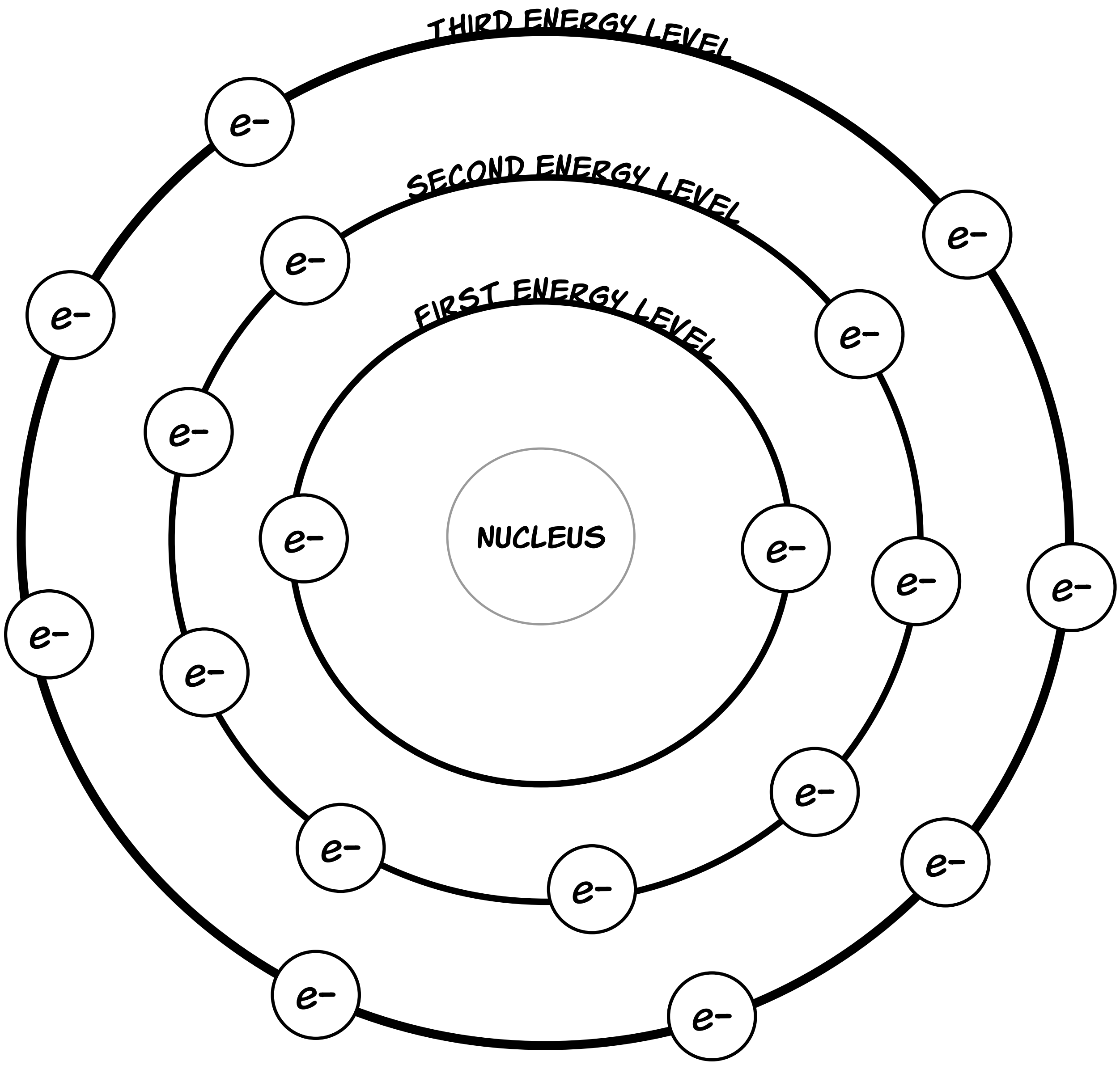
That leaves most of the atoms with electrons that are not yet in an energy level. The second energy level can fit UP TO eight electrons in it. That is a lot of moons in one orbit!

14. **Go to your marshmallow atoms and put all the remaining electrons in the second energy level around each nucleus. Do not bunch the electrons up; they should be spread evenly around the energy level.**

Instructor's Note:

- Every type of atom has one and only one amount of protons. That is what defines the type of atom. The number of electrons can change as a function of bonding. In the neutral state, as represented on the periodic table and with your student's marshmallow atoms, the number of electrons equals the number of protons. The number of neutrons, however, can vary without changing the type of atom. In fact, every type of naturally occurring element has a variable amount of neutrons. These atoms are called isotopes. Isotopes are atoms with the same number of protons but different numbers of neutrons. Every type of atom has isotopes. Here and throughout this book, only the most commonly occurring number of neutrons is used. The subject of isotopes will be covered in RSO Chemistry (level two).

ATOMIC ENERGY LEVEL CHART
MAXIMUM NUMBER OF ELECTRONS

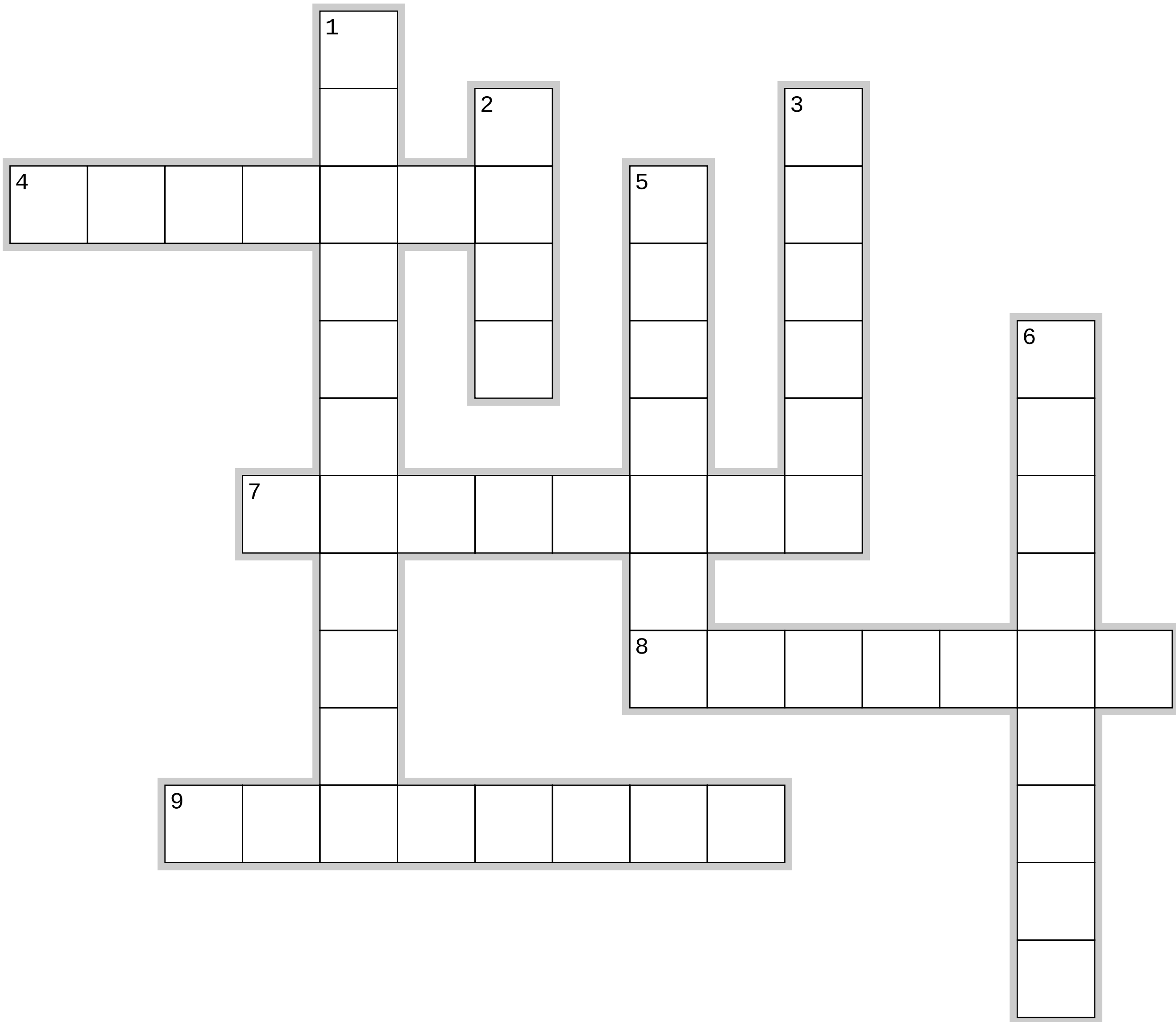


NAME ______________________________ DATE ____________________

Types! Lab: THE FIRST TEN

Hydrogen 1 neutron 0 proton 1 electron 1	**Carbon 6** neutron 6 proton __ electron __
Helium 2 neutron 2 proton 2 electron 2	**Nitrogen 7** neutron 7 proton __ electron __
Lithium 3 neutron 4 proton 3 electron __	**Oxygen 8** neutron 8 proton __ electron __
Beryllium 4 neutron 5 proton __ electron __	**Fluorine 9** neutron 10 proton __ electron __
Boron 5 neutron 5 proton __ electron __	**Neon 10** neutron 10 proton __ electron __

Starting Small – Crossword Vocabulary Review



Across

4. A group of the same type of atoms.
7. Negatively charged particle that orbits the nucleus.
8. The center part of an atom, where the protons and neutrons are found.
9. When atoms join together, they make this.

Down

1. Where the electrons are found. (Two words)
2. The basic building block of all matter.
3. A positively charged particle found in the nucleus of an atom.
5. A neutral particle found in the nucleus.
6. The process where things mix without being stirred.

Periodic Table of the Elements

Key: Atomic Number / Element's Symbol / Atomic Mass

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1st Period	1 H 1 Hydrogen																	2 He 4 Helium
2nd Period	3 Li 7 Lithium	4 Be 9 Beryllium											5 B 11 Boron	6 C 12 Carbon	7 N 14 Nitrogen	8 O 16 Oxygen	9 F 19 Fluorine	10 Ne 20 Neon
3rd Period	11 Na 23 Sodium	12 Mg 24 Magnesium											13 Al 27 Aluminum	14 Si 28 Silicon	15 P 31 Phosphorus	16 S 32 Sulfur	17 Cl 35 Chlorine	18 Ar 40 Argon
4th Period	19 K 39 Potassium	20 Ca 40 Calcium	21 Sc 45 Scandium	22 Ti 48 Titanium	23 V 51 Vanadium	24 Cr 52 Chromium	25 Mn 55 Manganese	26 Fe 56 Iron	27 Co 59 Cobalt	28 Ni 59 Nickel	29 Cu 64 Copper	30 Zn 65 Zinc	31 Ga 70 Gallium	32 Ge 73 Germanium	33 As 75 Arsenic	34 Se 79 Selenium	35 Br 80 Bromine	36 Kr 84 Krypton
5th Period	37 Rb 85 Rubidium	38 Sr 88 Strontium	39 Y 89 Yttrium	40 Zr 91 Zirconium	41 Nb 93 Niobium	42 Mo 96 Molybdenum	43 Tc 99 Technetium	44 Ru 101 Ruthenium	45 Rh 103 Rhodium	46 Pd 106 Palladium	47 Ag 108 Silver	48 Cd 112 Cadmium	49 In 115 Indium	50 Sn 119 Tin	51 Sb 122 Antimony	52 Te 128 Tellurium	53 I 127 Iodine	54 Xe 131 Xenon
6th Period	55 Cs 133 Cesium	56 Ba 137 Barium	57 La 139 Lanthanum	72 Hf 178 Hafnium	73 Ta 181 Tantalum	74 W 184 Tungsten	75 Re 186 Rhenium	76 Os 190 Osmium	77 Ir 192 Iridium	78 Pt 195 Platinum	79 Au 197 Gold	80 Hg 201 Mercury	81 Tl 204 Thallium	82 Pb 207 Lead	83 Bi 209 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
7th Period	87 Fr (223) Francium	88 Ra (226) Radium	89 Ac (227) Actinium	104 Rf (261) Rutherfordium	105 Db (262) Dubnium	106 Sg (263) Seaborgium	107 Bh (262) Bohrium	108 Hs (265) Hassium	109 Mt (266) Meitnerium	110 Ds (281) Darmstadtium	111 Rg (280) Roentgenium	112 Uub (285) Ununbium	113 Uut (284) Ununtrium	114 Uuq (289) Ununquadium	115 Uup (291) Ununpentium	116 Uuh (292) Ununhexium	117 Uus (292) Ununseptium	118 Uuo (293) Ununoctium