ATOMS, ELEMENTS AND COMPOUNDS

Grade 9

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Grade 9
Atoms, Elements, and Compounds

Materials in kit – to be returned to HCOS:

1. **Chemistry: Physical and Chemical Changes in Matter** Expanding Science Skills Series by Barbara Sandall
2. **Properties of Atoms & Molecules** (God’s Design for Chemistry & Ecology) text
3. **Properties of Atoms & Molecules** teacher supplement (with answers)
4. **Properties of Atoms & Molecules CD Rom** from Answers in Genesis
5. Exploring Physical Science: **Exploring Atoms and Molecules** by Nigel Saunders (much of the “Information” in this unit comes from this book)
6. **Package of materials:**
   - 10 rubber bands of the same size
   - Wooden clothespins
   - Red and blue litmus paper
   - one small ball of steel wool
   - Magnet
   - Thermometer
   - 15 pennies
   - steel paperclip
   - 2 eyedroppers
   - 2 medicine cups or clear vials
7. **Parent Guide** – the guide refers to links on the internet. See below for information on how to access them:

   The **Parent Guide and Student Pages** are available online for you to download. You can print as many copies of the student pages as you need. Just visit our L4U library, log in, and search for the Atoms, Elements and Compounds Unit Study. You will find the links in the library record.

   **ONLINE RESOURCE Required:**
   - **Basic Chemistry** – book available online, with written information and videos embedded in it.

**Websites – Contact your teacher for your username/password:**

Enchanted Learning web address:  [http://www.enchantedlearning.com/Home.html](http://www.enchantedlearning.com/Home.html)
Brain Pop:  [www.brainpop.com/](http://www.brainpop.com/)
Other books available from HCOS library

1. **Real Science 4 Kids Chemistry Level I** (for a slightly younger level, a good review)
2. **Exploring the World of Chemistry: from ancient metals to high-speed** computers by John Hudson Tiner
3. **The Mystery of the Periodic Table** by Benjamin Wiker
4. Usborne Illustrated Dictionary of Chemistry by Jane Wertheim
5. **The Usborne Internet-Linked Library of Science: Mixtures and Compounds** by Alastair Smith
6. **What's Chemistry All About?** By Alex Firth and Lisa Jane Gillespie

Other helpful book:
- Exploring Physical Science: **Exploring Chemical Reactions** by Nigel Saunders

**Science 9 Learning Outcomes Covered:**

1. Describe changes in the properties of matter
2. use modern atomic theory to describe the structure and components of atoms and molecules
3. use the periodic table to compare the characteristics and atomic structure of elements
4. write and interpret chemical symbols of elements and formulae of ionic compounds
5. demonstrate competence in the use of technologies specific to investigative procedures and research
6. demonstrate ethical, responsible, cooperative behaviour
7. demonstrate safe procedures
8. demonstrate scientific literacy
9. describe the relationship between scientific principles and technology
10. perform experiments using the scientific method
11. represent and interpret information in graphic form
**Materials Needed:**
- 2 L bottle of diet cola
- Mentos mints
- Thick or card paper
- Two balloons of equal size and shape
- String
- Metre stick or clothes hanger
- Balance for small masses
- 100 mL graduated cylinder
  - (or glass measuring cup with small intervals)
- Gumdrops
- Coloured mini-and large marshmallows
- Toothpicks
- Measuring spoons
- Matches
- Paper towels or coffee filter
- Bleach
- Vinegar
- Candle
- Plastic gloves
- 2 small jars with lid
- Metal spoon
- Goggles or sunglasses to protect the eyes
- Alka-selzer tablets
- Stopwatch
- Cooking oil
- Kitchen baster
- Salt
- Lemon juice, orange juice
- Bottled water
- Lemon-lime soda
- Ammonia
- Baking soda solution
- 9 Plastic cups
- Paper towels
- Dish soap
- Food colouring
- Disposable diaper
- White glue
- Liquid starch
- Plastic Ziplock bag
- Colouring markers
**Unit Study:**

This unit is designed to be completed over a period of seven weeks with three 45-60 minute lessons per week. There are a number of enrichment activities which have not been calculated as part of those time estimates. The Unit progresses through *Properties of Atoms & Molecules* and *Chemistry: Physical and Chemical Changes in Matter*.

**NOTE:** All books used in these units are passed on in pristine condition so any answers or filling in the blanks must be written on a photocopy of these pages or on lined paper in a duotang. DO NOT WRITE on the books in this resource kit.

**How do I teach Creation vs. Evolution?**

Children will encounter this idea of the earth being millions of years old and other evolutionary ideas in some books or videos, so please be prepared. For more information, you can consult the Institute for Creation Science at [http://www.icr.org/](http://www.icr.org/).

**Dear Parents,**

This unit explores the building blocks of all that God created, namely atoms and how they combine to make all that we see. There are 16 lessons to be completed over a seven week period which include devotions from Scripture, various reading, watching videos or other instructive clips, doing experiments, discussing concepts and writing answers or lab reports. This will complete the requirements necessary for the Grade 9 learning outcomes listed above. At the end there’s a list of portfolio submission suggestions of things you can show your teacher to show the work done in this unit.

Isaiah 42:5-9
Isaiah 28:23-29 - how to prepare the field for planting

**Day 1: Lesson 1: Introduction**

Daily devotion: Isaiah 44:6-20 As we study what God has created, we must never place His creation above God. We cannot make an idol of what He’s created, of science or technology or progress. What we see and study should make us stand more amazed at who God is and worship him.

Do: Soda Fountain chemical reaction (Properties of Atoms & Molecules p. 9)
Do: Another Chemical Reaction from *Easy Genius Science Projects with Chemistry* (See worksheet with 2.7 at top and p. 54 at the bottom)
Read: *Properties of Atoms & Molecules* pp 8-9
Read: *Chemistry: Physical and Chemical Changes in Matter* p.6, 11
Write: answers to Quick Check on p. 12 of *Chemistry: Physical and Chemical Changes in Matter*
Write what John Dalton’s Atomic Theory of Matter stated.

Activity #1 and #2 on p. 13 of *Chemistry: Physical and Chemical Changes in Matter*

Do: “Atomic Models” worksheet on *Properties of Atoms & Molecules* CD

Think about it: How can you tell that a chemical reaction took place in the Soda Fountain?

How can you tell a chemical reaction took place on the steel wool? Would you be able to get the original steel wool and vinegar back?

Materials needed: 2L bottle of diet cola, heavy paper (cardstock), tape, toothpick, Mentos mints, steel wool that has no soap (hardware store), a jar, vinegar, 2 eyedroppers, metric measuring cup, 2 medicine cups or clear vials, household ammonia

Enrichment: If you want you can read *Chemistry: Physical and Chemical Changes in Matter* Unit 1: Historical Perspective pp. 3-7

Enrichment: watch Discovery Education video “*Elements of Chemistry: Atoms: the Building Blocks of Matter*”

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**Day 2: Lesson 2: Atoms**

Daily devotion: Isaiah 48:3-13

Read: *Properties of Atoms & Molecules* pp 10-15

Read: *Chemistry: Physical and Chemical Changes in Matter* pp. 15-17

Information: Pictures from laser and inkjet printers are made from thousands of dots of ink. The more dots per inch, the better the resolution and clarity of the picture, but the dots have to be really tiny. This is similar to matter in general: atoms are incredibly tiny and crammed together so closely that we cannot see them; we only see the matter itself. We cannot see individual atoms using an ordinary microscope, but they can be detected using a special one called a scanning tunneling microscope.

Write: answers to the questions on page 12 of *Properties of Atoms & Molecules*

Do: Quick Check p. 18 in *Chemistry: Physical and Chemical Changes in Matter*

Do: make a 3-D model of an atom; look at the top of p. 19 of *Chemistry: Physical and Chemical Changes in Matter*

Do: "Energy Levels" worksheet on the “Properties of Atoms & Molecules” CD

Think about it: Positive charges repel each other. What holds positive protons and neutrons together in an atom’s nucleus?

Enrichment: look at this [History of the Atomic Structure](#)

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**Day 3: Lesson 3: Atoms and their Subatomic Particles**

Daily devotion: Genesis 2:5-9, 18-23. We can synthetically create many chemicals using what God has already made, but He is the only one who can create “ex nihilo” out of nothing. We cannot make anything come to life, but in this passage we read how the breath of God brought Adam and Eve to life. How does God’s breath and Spirit affect each of us, as believers?
Read: Properties of Atoms & Molecules pp 22-27
Watch the Brain Pop episode “Periodic Table of Elements” and do the activity sheet
Write: answers to the questions on page 24 of Properties of Atoms & Molecules
Think About:
Enrichment or extra practice: “Learning About the Elements” worksheet on the Properties of Atoms & Molecules CD

Day 4: Lesson 4: Building Atoms and Elements

Devotion: Ezekiel 37:1-14 This passage builds on what you read yesterday. When was this prophesy fulfilled? How are we like the dry bones of this valley? What does God do for us to raise us to new life? What hope does He give us?

Read: Properties of Atoms & Molecules pp 17-20
Write Answers: to questions on p. 19 of Properties of Atoms & Molecules and “What Am I” worksheet from the CD

Create models of Atoms, Elements, Molecules and Compounds (taken from Easy Genius Science Projects with Chemistry by Robert Gardner): Let the paper clips represent atoms of the element “C” for clips and the washers represent atoms of the element “W”. Notice that all atoms of one element have the same shape, look and weight. If you mix them together, you have a physical mixture (like dissolving sugar in water) but not a chemical reaction because the “C” atoms look still look like before as do the “W” atoms. A chemical reaction occurs when the basic component has been changed to create a molecule of atoms joined in a specific arrangement. Other than 1:1, in what ratios could the atoms of C and W combine? (1:2, 1:3, 2:1, 2:3 etc.)

a. Prepare a large number of “molecules” each having one washer attached to one clip (CW). Weigh all of these and record the weight (1). Next “decompose” the compound by pulling the washers off the clips and weigh the atoms of both elements (clips and washers) and record the weight (2). Now weigh separately the clips from the molecules you decomposed and record the weight (3) and then the washers (4) from the molecules you decomposed. Add the weights together and compare with weight 1 of the molecules and weight 2 of the decomposed molecules. How do these numbers illustrate the fact that matter is neither created nor destroyed? Make a ratio of Weight 3:Weight 4 and reduce the ratio to lowest terms.

b. Prepare a large number of “molecules” again, this time with each molecule containing 2 clips and one washer hooked together (C$_2$W). Follow the same procedure as in step a and also find the new ratio in lowest terms. How does this relate to the ratio in step a for CW?

c. Prepare a large number of “molecules” again, this time with each molecule containing one clip and two washers hooked together (CW$_2$). Follow the same procedure as in
step a, and also find the new ratio in lowest terms. How does this relate to the ratio for CW and C_2W?

Read Background information: John Dalton’s Atomic Theory hypothesized that atoms of any one element are identical and differ from the atoms of any other element in properties such as weight. Since atoms are indestructible, there is no change in weight when a physical or chemical reaction occurs leading to the law of conservation of matter (matter is never created or destroyed and weight is never lost or gained in reactions). A French chemist, Joseph Louis Proust, had already analyzed many compounds, leading to the law of definite proportions, which indicates that each compound always has a particular fixed ratio by weight of the original atoms combined. For instance, oxygen’s weight is 16 g compared to hydrogen’s one gram (Periodic table) so water (H_2O) always has a ratio of 16:2 or 8:1 for O:H. You also found the law of multiple proportions in your model (steps a-c) which states that if two elements form more than one compound, the weight ratio of the elements in one compound will be a simple multiple of the weight ratio in the other compound(s). For example chemists found the weight ratio of oxygen to carbon in carbon monoxide is 4:3 and in carbon dioxide it is 8:3 showing there is twice as much oxygen in the second compound.

Review these concepts by going through Evernote’s powerpoint on Elements, Compounds and Mixtures, stating which each example is before moving to the next slide to check your answer. You can click on the links at the end if you want to see more explanation on any of these terms.

Think About: the order of God’s creation and how the subatomic particles allow only about 100 elements to make all the different materials we see and use in our world!
Materials needed: for models of Atoms etc.: large identical paper clips, small identical washers, a scale or balance pan to weigh small amounts
Enrichment: read Properties of Atoms & Molecules pp 16-17

Day 5: Lesson 5: The Four States of Matter

Daily devotion: Psalm 147 – What states of matter (water) are mentioned in this psalm? How do we see that God is in control of these as well? This psalm mentions God knowing the stars by name. Read Philippians 2:14-16 and notice that we are like stars. In what ways do we shine? How does this psalm encourage us to shine? Isn’t it amazing that God knows each of us by name as well and knows our number, the number and name of every human being on earth?

Read: Chemistry: Physical and Chemical Changes in Matter pp. 20-27
Do: Quick Check on p 27, Activity #2 on p 23 and Inquiry Investigation: Air on p 24 of Chemistry: Physical and Chemical Changes in Matter

Information: Plasmas form when electrons are removed from particles of gas by heat or electricity, leaving hot electrically charged particles (electrons and positive ions) behind. Plasmas are found in the sun, flames, fluorescent lights, neon lights and plasma televisions. The colder a solid gets, the more slowly its particles vibrate. The temperature at which they stop vibrating is called absolute zero, which is at -273.15 degrees Celsius.
Fill in the blanks:  A ______ has no shape or volume of its own.  Heat makes the particles in matter move ________ When ice melts it becomes ________ water.  When water is heated to a boil it becomes ________________ .  Any reversible change in the size, shape or volume of matter is called a ________________ change.  When matter loses heat and cools, the particles ________.  A _______ has its own volume but changes shape with its container.  A _______ keeps its shape and a constant volume.

Think about it:  How have we progressed rapidly in the past decade in using plasma in technology?

Enrichment: Take a diagram of the water cycle and label where the water is found as solid, liquid or gas and also label the process that is occurring in each place (condensation, evaporation, melting, freezing, etc.)

Materials needed: 2 balloons of equal size and shape, three 30cm pieces of string, 1 pushpin, 1 metre stick, tape

**Day 6: Lesson 6: The Physical Properties of Matter**

Daily devotion: Leaven: Matthew 16:5-12, Luke 12:1-3, 1 Cor 5:6-8 Leaven is yeast; research the characteristics and effects of yeast as it grows.  Just as yeast works its way throughout the entire batch of dough, so our attitudes and beliefs affect all we do and say.  Also, the physical properties we see of the dough points to the presence of the yeast, and how we act and speak makes it plain what our attitudes and beliefs are. Matter has specific physical properties, depending on what it is, and we as Christians must also have specific ways of speaking and acting which show that we really are children of God.  Do your attitudes, actions and words outwardly show the presence of the Holy Spirit in your heart?

Read: Properties of Atoms & Molecules pp 28-30
Read: Chemistry: Physical and Chemical Changes in Matter pp. 30-33, 38-39

Background Information:  If the name of an element ends in”um” it belongs to a metal, with the exception of helium.  Helium is actually a non-metal.  When it was first detected by studying sunlight, most elements discovered had been metals, so it was assumed helium was too.  When it was finally isolated in 1895, it was found to be a non-metal but by then it was too late to change its name.  Metals are good conductors of heat and electricity because free electrons can carry thermal energy from the hot end to the cool end or electrical energy through their movement.  The atoms of metals are packed together tightly so they are dense or heavy for their size.  They are also all solid at room temperature except for mercury.  Osmium is the densest metal – a teaspoon of it weighs 113 grams. The atoms of a metal are regularly arranged with strong forces holding them together.  This is why metals are usually strong, hard and tough and why they are useful for making cars, buildings, bridges and ships.  When a piece of metal is bent, layers of its atoms can slide over each other so that it doesn’t usually shatter or snap.

Write: answers to Quick Check on p. 33 of Chemistry: Physical and Chemical Changes in Matter
And questions on p 29 of *Properties of Atoms & Molecules* as well as “Reactivity Series” worksheet on the CD
Do: Inquiry Investigation: Density on p. 35-36 of *Chemistry: Physical and Chemical Changes in Matter* on lined paper and create a graph like the one on p. 36 on graph paper or photocopy p. 35-36
Enrichment: Write answers to the questions on page 40 of *Chemistry: Physical and Chemical Changes in Matter*

Materials needed: kitchen scale or triple-beam balance and masses, water, paper towels, 1mL graduated cylinder, various small objects (blocks, balls, rocks, etc), metric ruler, green or blue food colouring, drinking glass, cold water, sugar, spoons, warm water, kitchen baster, eyedropper, cooking oil, quiet place, graph paper

**Day 7: Lesson 7: Important Elements**

Daily devotion: 1 Peter 1:3-9  God knows that metals must be heated to be purified and to get rid of impurities. In this text, to what does he compare this purification process? What provides the “fire” to purify us? What is the outcome God intends? How should this encourage us in very difficult times?

Read: *Properties of Atoms & Molecules* pp. 31-34, 38-39
Watch: You can heat and cool water virtually at this website to review how it changes states.
Information: Because the noble gases have a full valence shell of electrons, they do not react with other elements. They keep themselves apart, just as noblemen used to keep away from common people. The noble gases exist as single atoms, but all the other non-metal elements exist as molecules, most of them diatomic (two atoms joined together) which enables each of them to “feel” like their valence shell is full as they share electrons.
Answer questions: on p. 33 and 39 of *Properties of Atoms & Molecules*

Use periodic table on p. 26 of *Properties of Atoms & Molecules*.
Do: Elements Matching.docx activity
Do: a Quick Intro to Elements animation and explanation at Science Joy Wagon and also review symbols and names with “It’s Elemental Flash Cards”.
Enrichment: do the “Learning about the Elements” worksheet on the *Properties of Atoms & Molecules CD*.

Create: My Favourite Element Video
Using the Claim/Evidence/Reason model, create a short video explaining why the element you chose is your favourite element. In the Claim/Evidence/Reason model, you state your claim in 1-2 sentences, then list evidence and then describe how this evidence supports your claim that _____ is the best element. The beginning of your video should introduce your claim and it needs to include 4 examples of evidence to show why this element is your favourite and why it’s important. When deciding which element is your favourite, be sure to consider the physical and chemical properties of your element. What state of matter is it at room temperature? Does it
react with other elements? What other physical and/or chemical properties are unique or impressive about your element? What is it used for and how does it combine with other elements? Your video should be 1–2 minutes in length.

**Day 8: Lesson 8: Physical Changes in Matter**

Daily devotion: Exodus 5:6-21 To build Egyptian cities, the Israelites gathered straw to mix with mud to make bricks. Did brick making involve a physical or chemical change? Was the accusation of the Israelite leaders correct? Why or why not? Was Pharaoh’s reaction unpredictable by God or was God allowing him to do this to His people? Why? How does this help you understand how God works in your life?

Read: *Chemistry: Physical and Chemical Changes in Matter* pp. 44-46
Watch: You can heat and cool water virtually at this website to review how it changes states.

**Information**: Diffusion in gases happens much more quickly than diffusion in liquids, because the particles in gases move more quickly than the particles in liquids. Thomas Graham studied diffusion in gases and discovered that the higher the mass of an atom or molecules, the more slowly if diffused from place to place. For example, oxygen molecules have 16 times the mass of hydrogen molecules and diffuse four times more slowly. Graham's Law can be used to compare gases to work out the masses of their molecules. Most substances expand to fill more space when they are heated up and they contract to fill less space when they are cooled down. The size of the atoms or molecules doesn’t change, but the distance between them gets bigger or smaller depending on the movement of those particles. They vibrate faster and move apart as they are heated and get more energy and they vibrate slower and settle in closer when they are cooled (more dense).

This is why steel railroad lines need to have gaps between (called expansion joints) so they don’t bend and buckle. This is also why mercury or alcohol inside a thermometer rises up the tube on a hot day and why hot air in a hot air balloon is less dense than the cold air around it, causing the balloon to rise. We can stand amazed at God’s ingenuity in creating water to do the opposite; it expands rather than contracting as it cools and freezes! This is because water molecules are polar (have a slightly positive side and a slightly negative side) and arrange themselves in a regular way as these ends are attracted to each other. This lattice takes up more space.

Write answers to these questions: 1. Describe what happens to the particles of solids and liquids as they are heated. 2. What do you know about the bonds between particles of substances with high melting points and boiling points? 3. What happens to the particles of gases and liquids when they are cooled? 4. Explain (several ways of) how to speed up diffusion, giving the reasons why this work using the atomic theory of matter.

Do: Quick Check on p. 47 of *Chemistry: Physical and Chemical Changes in Matter* on lined paper
Do: Activities #1 (you can use a glass bottle and hold partially submerged in a pan of water which you heat on the stove) and #2 (use clear cups so you can see through them) on p. 48
Do: Diffusion Experiment.jpg (taken from *Easy Genius Science Projects with Chemistry: Great Experiments and Ideas* by Robert Gardner)
Enrichment: Read about Mixtures in pp.32-37 of *Exploring Atoms and Molecules*
Day 9: Lesson 9: Ions and Ionic Bonding

Read *Properties of Atoms & Molecules* pp. 45-48

Watch Brain Pop episodes “Chemical Bonds” and read the FYI section.

Information: When a metal atom and a non-metal atom join together, they make a type of bond called an ionic bond. These bonds form when the metal atom gives one or more electrons to the non-metal atom, forming electrically charged particles called ions. Metal ions are positively charged (losing the few electrons in their valence shell) and non-metal ions are negatively charged (gaining electrons to fill their valence shell). These oppositely charged ions attract each other strongly, making bonds which require a lot of energy to break. Many ionic compounds are white or colourless, containing metals from the first two columns of the periodic table. If the compound contains a metal from the wide central block of the periodic table, such as copper or chromium, it is likely to be coloured. In fact, most precious stones are ionic compounds which would be colourless without metal atoms such as chromium, iron and manganese inside them.

Write: answers to the questions on page 47

Do: Atomic Models on p 46

Do: all pages of this excellent interactive worksheet on atoms EXCEPT for Ionic Structures and the following page with pictures of ions, Metallic Bonding and Explaining Reactivity

Day 10: Lesson 10: Covalent Bonding

Daily devotion: Genesis 17:1-14 In this passage God makes a covenant with Abraham, the father of all believers. The word covenant comes from the Latin word *convenire* which means “to come together, to be agreed upon” (cf. Webster’s New World Dictionary). What did God agree to do for Abraham? What was Abraham agreeing to do for his part of the covenant? “Covalent” comes from the same Latin root word. In what way are covalent bonds related to the meaning “to come together, to be agreed upon”?

Read *Properties of Atoms & Molecules* pp. 49-51

Click here or here at Discovery Education (Standard Deviants School Organic Chemistry: The Basics – Lewis Structures Video segment) for a tutorial on how to draw Lewis Dot diagrams.

Read through this excellent pdf file by Douglas Gilliland explaining how to name ionic and covalent compounds.

Read: Lesson on Naming Compounds.docx

Do questions on the pages in the file named “Naming Compounds Worksheet.docx” using this Periodic table with charges shown and the “Polyatomic Ions reference” sheet as needed.

Enrichment: for more practice in naming compounds, get worksheets from The Cavalcade o’ Chemistry | Your online chemistry source since 1998 or thereabouts

Write: answers to the questions on page 50
Do: Ionic Vs. Covalent experiment on p 51
Materials Needed: “Bonding Experiment” worksheet from the CD, 4 paper cups, distilled water, copper wire, 9 Volt battery, baking soda, sugar, salt, olive oil
Do: Chemical Bonding Terms matching quiz.doc
Enrichment: Read about Metallic bonding in Properties of Atoms & Molecules pp. 52-53

**Day 11: Lesson 11: Chemical Reactions**

Daily devotion: John 2:1-11 Jesus is LORD also of chemical reactions, producing wine out of water which is, humanly speaking, impossible. What other amazing miracles did he perform, as recorded in the gospels? What amazing miracles does he work in your life?

Read: Properties of Atoms & Molecules pp 67-70
Read: Chemistry: Physical and Chemical Changes in Matter pp. 51-53
Write: answers to the questions on page 69 of Properties of Atoms & Molecules

Do: Inquiry Investigation: Oxidation on p. 61-62 of Chemistry: Physical and Chemical Changes in Matter, using also the ideas in the blue box on p. 80 of Properties of Atoms & Molecules and measuring the temperature change every five minutes
Write answers to the “Physical and Chemical Change Worksheet.doc”. (2 pages)
Do: “Another Chemical Reaction” taken from Easy Genius Science Projects with Chemistry: Great Experiments and Ideas by Robert Gardner
(You can videotape the following activity for your teacher to watch as a portfolio submission.)

Build some atomic Models using marshmallows and following instructions on p. 46 and 50 of Properties of Atoms & Molecules
Look at the animation “Shapes of Simple Molecules” (scroll down to see the white box with blue line across the top); skip the last part involving names of different molecule shapes. “Build” some of these molecule models using marshmallows (as atoms – choose large marshmallows for big atoms, and one colour for atoms of the same element) and toothpicks (for the bonds). Click on the “repel” button to see how the negatively charged electron bonds push away from each other. Show the difference between physical and chemical changes using the marshmallows as atoms and linked marshmallows (with toothpicks) as molecules. Show these situations: 1. A solid chunk of gold atoms is cut in half. 2. The gas Helium is mixed with Hydrogen (each of these are gases of atoms) 3. The gas Oxygen (diatomic molecules) is mixed with Helium. 4. The gas Oxygen (diatomic molecules) is mixed with Hydrogen and reacts to form water (H₂O). 5. Liquid water is heated and evaporates to become a gas. 6. Carbon monoxide (CO) reacts with Oxygen (O₂) to form carbon dioxide (CO₂). 7. Carbon dioxide and oxygen are mixed in air but don’t react.

Materials needed: one small ball of steel wool, magnet, measuring spoons, matches, water, paper towels or coffee filter, 20 mL bleach, 10 mL vinegar, candle, plastic gloves, 2 small jars, thermometer, metal spoon, goggles or sunglasses to protect the eyes, small coloured marshmallows, toothpicks, large marshmallows
Day 12: Lesson 12: Chemical Changes and Equations

Daily devotion: Matthew 25:1-13  Fuel is a covalent carbon compound which combines with oxygen and burns to produce water and carbon dioxide. What kind of fuel do we need as we wait for the glorious second coming of our saviour? How do we make sure we keep getting enough fuel as we wait? How do we “burn brightly” for Jesus in this world?

Read: Properties of Atoms & Molecules pp 71-74
Read: Chemistry: Physical and Chemical Changes in Matter pp. 57-58
Do: Quick Check on p 59 of Chemistry: Physical and Chemical Changes in Matter
OPTIONAL: watch the Brain Pop episode “Conservation of Mass”
Watch: Brain Pop episode “Chemical Equations”

Information: “Physical Changes such as freezing, boiling and evaporating do not result in new substances. Ice is still water when it melts. Chemical changes, however, cause the formation of at least one new substance. Atoms are rearranged, new molecules are formed, and energy is usually absorbed or released. There are several ways to tell that a chemical reaction is taking place. A gas may be produced. If the gas is formed in a liquid, there will be bubbles and, perhaps, fizzing. A solid (precipitate), sometimes coloured, may form and settle out of a liquid. Heat and light may be released as happens when something burns. Reactions that produce heat are called exothermic reactions. There may be a drop in temperature as reactants (the substances that react) form products (new substances) if energy is absorbed. Reactions accompanied by a drop in temperature are said to be endothermic. Other chemical reactions are accompanied by colour changes or changes in acidity.” p. 39 of Easy Genius Science Projects with Chemistry: Great Experiments and Ideas by Robert Gardner

Write: answers to the questions on page 73 of Properties of Atoms & Molecules
Do: “Reactants and Products Worksheet” of CD of Properties of Atoms & Molecules
Enrichment: Go to Jefferson Lab’s It’s Elemental Balancing Act and select some equations to try.
Enrichment: Review these concepts and see some examples by reading Changes in Matter.

Day 13: Lesson 13: Types of Reactions and Factors Which Affect their Rates

Daily devotion: Matthew 9:14-17 (new wine into old wineskins)

Read: Properties of Atoms & Molecules pp 75-82
Read: Types of Chemical Reactions at CK- Basic Chemistry and take notes placing each type of chemical reaction as a subtopic on this Idea Diagram and writing examples and descriptions as details
Write: answers to the questions on page 77 and 81 of Properties of Atoms & Molecules
Fill in the Chart (Activity #1): at the top of p 60 of Chemistry: Physical and Chemical Changes in Matter
Do: Temperature & Surface Area experiments on p. 70 of Properties of Atoms & Molecules and filling out the “Reaction Rate Experiment” worksheet from the CD
Optional Experiments to do: Blue Box entitled “Catalysts and Inhibitors” on p. 76 of *Properties of Atoms & Molecules*
Materials needed: Alka-selzer tablets, stopwatch, stove, pan, three clear cups
Materials needed for optional experiments: potato, hydrogen peroxide, apple, lemon juice

**Day 14: Lesson 14: Acids, Bases and Salts**

Daily devotion: Matthew 5:13-20, Luke 14:34-35 What properties does salt have that Jesus is calling for us to imitate?

Read: *Properties of Atoms & Molecules* pp 87-95 (skip blue boxes on p. 88 and on p.91); read through also the green boxes
Read: *Chemistry: Physical and Chemical Changes in Matter* p. 53

Make Models: of Acids and Bases taken from *Easy Genius Science Projects with Chemistry: Great Experiments and Ideas* by Robert Gardner p.44-45
Write: answers to Quick Check on p. 54 of *Chemistry: Physical and Chemical Changes in Matter* and both Activities on p 55
Write: answers to the questions on page 89, 92 and 95 of *Properties of Atoms & Molecules*

Do: Inquiry Investigation: Acids and Bases on p. 56 of *Chemistry: Physical and Chemical Changes in Matter*
Do: Displacement Reaction on p. 89 of *Properties of Atoms & Molecules*
Materials needed: gumdrops (or marshmallows) and toothpicks, 15 pennies, jar with lid, salt, vinegar, steel paperclip, lemon juice, bottled water, orange juice, vinegar, tap water, red and blue litmus paper, pH colour chart, salt water, lemon-lime soda, ammonia, baking soda solution, 9 plastic cups

**Day 15: Lesson 15: Applications of Chemistry**

Daily devotion: Matthew 9:10-13, 18-26 In this lesson we learn about medicines God’s given in creation, but God is the one who gives healing, through medicine, the work of doctors and supernaturally. Jesus isn’t just talking about healing of the body. How does God work healing in you spiritually, emotionally and in every other way?

Review the previous lesson by doing the worksheet “Acid Base Reactions” from the CD.
Read: *Properties of Atoms & Molecules* pp 96-97, 109-112, 119-122
Watch video at Discovery Education: *Elements of Chemistry: Compounds and Reactions.*

Write: answers to the questions on page 111 and 122 of *Properties of Atoms & Molecules*
Watch: Brain Pop “Plastic”

Enrichment Lesson: Learn more about applications of Chemistry by reading any or all other sections of interest in *Properties of Atoms & Molecules* pp 99-133
Day 16: Lesson 16: Fun with Chemistry – Conclusion

Read and do any or all of the experiments on pp. 134-135 of Properties of Atoms & Molecules and do the “Fun with Chemistry” worksheet from off the CD

You can do any/all of the quizzes found on the CD for Properties of Atoms & Molecules except Quizzes 6 and 7 since this material was not fully covered.

Portfolio Submission Guidelines:

Students will submit three samples for each portfolio. Please submit at least one experiment log in each portfolio.

Lab report showing title, purpose, hypothesis, procedure, materials, experiment, results, conclusion and graph on Inquiry Investigation: Density or any other experiment
3D model of atoms and compounds
Completed quick checks
My Favourite Element Video Using the Claim/Evidence/Reason thinking model
Completed pages from “Element Builder” (Gizmo on Ions)
An experiment log showing the planning and conducting of an experiment that controls for two or more variables
A photo or diagram of a model the student created to help explain scientific concepts, and hypotheses
An experiment log that identifies all of the steps in an experiment including a testable question, a hypothesis, materials, procedures, controlling variables, manipulating one variable, observations, and conclusion.
A marked test (or a test with an answer key)
Written answers to questions from the text showing an understanding of the topics listed above
A chart or graph showing the student’s observations, experiences, or thinking.
A chart that classifies objects, events, or organisms based on criteria determined by the student.
Written notes or observations including the student’s ideas about what the outcome of an experiment would be
An oral recording of the student discussing any of the above content.
A photograph of the student doing an experiment or a photograph of a project
Any artwork the student has created as he made observations.
A written (or oral) summary of any reading the student has done on the above topics.
A labeled diagram