Colossians 1:16 For in him all things were created: things in heaven and on earth, visible and invisible, whether thrones or powers or rulers or authorities; all things have been created through him and for him. 17 He is before all things, and in him all things hold together.
Introduction

The Ministry of Education has recently changed the learning standards and competencies for the Province of British Columbia. This kit is designed with these standards in mind. Each activity in this Unit Study addresses the competencies of the new BCEd Plan, and is marked with the following labels:

<table>
<thead>
<tr>
<th>Communication Competency</th>
<th>Critical Thinking Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative Thinking Competency</td>
<td>Personal &amp; Social Competency</td>
</tr>
<tr>
<td>Thinking Competency</td>
<td>Social Responsibility</td>
</tr>
</tbody>
</table>

For further information on the pedagogy behind the kits please check out the context in this document. It will help give background to the new BC curriculum and our inclusion of these new learning standards in our Unit Study Kits.
Big Ideas
“Big ideas are statements that are central to one’s understanding in an area of learning. A big idea is broad and abstract.” (CT) Big ideas represent the overarching theme of each unit. They contain references to the content and key questions students will be investigating throughout the unit. Big ideas are often cross-curricular in nature. Similar themes can be found in many different subject areas within each grade-level.

Science
The behaviour of matter can be explained by the kinetic molecular theory and atomic theory.

Curricular Competencies
“Competency represents the combined skills, processes, behaviours and habits of mind that learners use to make sense of the world.” (CT)

Science

● Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest
● Make observations aimed at identifying their own questions about the natural world
● Identify a question to answer or a problem to solve through scientific inquiry
  ● Formulate alternative “If…then…” hypotheses based on their questions
    ● Make predictions about the findings of their inquiry
● Collaboratively plan a range of investigation types, including fieldwork and experiments, to answer their questions or solve problems they have identified
● Measure and control variables (dependent and independent) through fair tests
  ● Observe, measure, and record data (qualitative and quantitative), using equipment, including digital technologies, with accuracy and precision
● Ensure that safety and ethical guidelines are followed in their investigations
  ● Experience and interpret the local environment
● Construct and use a range of methods to represent patterns or relationships in data, including tables, graphs, keys, models, and digital technologies as appropriate
● Use scientific understandings to identify relationships and draw conclusions
● Reflect on their investigation methods, including the adequacy of controls on variables (dependent and independent) and the quality of the data collected
● Identify possible sources of error and suggest improvements to their investigation methods
● Demonstrate an awareness of assumptions and bias in their own work and secondary sources
● Demonstrate an understanding and appreciation of evidence (qualitative and quantitative)
● Exercise a healthy, informed skepticism and use scientific knowledge and findings from their own investigations to evaluate claims in secondary sources
● Consider social, ethical, and environmental implications of the findings from their own and others’ investigations
● Communicate ideas, findings, and solutions to problems, using scientific language, representations, and digital technologies as appropriate
● Express and reflect on a variety of experiences and perspectives of place

Content and Key Questions
Content refers to the topics that will be investigated throughout the unit. The key questions serve as a guide as you and your child explore the content. Throughout this unit the key questions will be the starting point for learning.

Science
Content: kinetic molecular theory (KMT)
● Elaborations: explains how particles move in different states

Content: atomic theory and models
● Elaborations: provides evidence for the existence of atoms and molecules
● Elaborations: models can be used to represent:
  ○ the arrangement and motion of particles in different phases
  ○ the arrangement of and forces that bind protons, neutrons, and electrons in an atom
  ○ the quarks and leptons in protons, neutrons, and electrons

Content: protons, neutrons, and quarks
● Elaborations: protons and neutrons (made of quarks) are held together in the nucleus by a strong nuclear force
How to Use This Kit

The Ministry of Education is in the final stages of overhauling curriculum, learning strategies, and learning goals for students in the Province of British Columbia. This kit is designed with those goals in mind. On the next several pages you will discover the content that serves as the “bulk” of this kit. Rather than being divided by day, the unit plan uses the key questions detailed on page 8 to breakdown content, activities, and experiences.

Each key question will have books to read from the HCS Overdrive E-Library, (if you do not have your client code & pin, please contact Shandra Wiebe at swiebe@onlineschool.ca), videos to watch, and activities to share with your child. You will not be required to complete all activities listed under each key question, instead, you will be able to choose activities which most appeal to you and your child. Each key question featured in the unit will include recommendations on how many activities to complete in order to fully address the curriculum content and competencies. Finally, each activity will have icons (shown on pages 2 and 3) showing which goals of the BCEd Plan the activity addresses.

***You are encouraged to choose varied activities to ensure all goals are being addressed. In order to fully meet the goals of this kit, it is important to read many of the recommended books.***

Reading and discussing/watching and discussing the books and videos listed in this unit will consistently address the goals of the BCEd Plan denoted by the following symbols which are explained in detail at the beginning of this kit:

- Phone
- Bear
- Book
- Children

It is our hope that our redesigned format will allow for flexibility, individual preference, and student-centered learning. When selecting activities to complete with your child we recommend selecting a variety of activities to ensure that you touch on each BCEd Plan goal throughout the unit.
**Unit Guide**

**Important Note:** The recommended number of activities per section is meant to serve as a guide. Families are encouraged to make the kit their own and complete the number of activities that they, and their support teacher, feel are necessary. We recommend choosing three larger activities along with a combination of smaller, less time-consuming, activities. This kit is designed to be completed over a six-week period. Books marked with an *** are necessary for fully covering the content and ensuring a thorough understanding of the material.

**Science Safety:** When completing science experiments, and all other science experiments, it is extremely important to be safe. Science is an amazing discipline, fun, intriguing, exciting, but it can also be dangerous. Following safety guidelines, having a plan before beginning an experiment, and ensuring that you have an adult present at all times can help to keep you safe when conducting experiments. Brainstorm a list of what you think some important science safety rules are. Then, watch [this fun video](#) from I Think School to learn more about lab safety. *When working with chemicals and materials in science experiments, it is important that you never touch your eyes or your face. Never eat or drink food while you are conducting science experiments, always save your snacking until later.*

**Chemistry Journal:** After reading the books in this unit, you will be answering questions in your chemistry journal. A printable journal is available [here](#). If you prefer, you could also answer the questions in a video or audio recording, using a Padlet, or in a word processing program such as Microsoft Word, Pages, or [Google Docs](#). The printable journal also has vocabulary activities that will be helpful to complete prior to beginning the unit.
Books to Read and Talk About:

Atoms and Molecules by Tracy Nelson Maurer
After reading this book, you will be answering questions in your chemistry journal. A printable journal is available here. If you prefer, you could also answer the questions in a video or audio recording, using a Padlet, or in a word processing program such as Microsoft Word, Pages, or Google Docs. The printable journal also has vocabulary activities that will be helpful to complete prior to beginning the unit.

Videos to Watch and Talk About:

Learn 360:
Chemical Bonding and Atomic Structure
Chemical Reactions
Atoms and Molecules

Discovery Education:
Kinetic Molecular Theory of Gases
Kinetic Molecular Theory
What is Kinetic Energy?

Activities (Select 2-3):

Exploring KMT: For this activity you will be researching Kinetic Molecular Theory, and creating a project or presentation to teach others. To start, watch The Kinetic Theory of Matter. Then, use Explora and World Book Student to research the KMT. Your project should include the basics of the theory and examples. For this project you can select one of the following presentation forms:
- Design an infographic in Canva
- Create a poster
- Make a brochure using Canva
- Make a multimedia presentation such as an Edubuncee
- Create a digital science video
- Build a Padlet
- Make a Wix or Weebly page
- A Prezi
- A presentation method of your choosing

Molecules Matter: What do you know about molecules? Spend some time watching Atoms and Molecules from Learn 360. Try this fun activity, "Molecules Matter", from ACS Chemistry for Life to learn more about molecules. For this experiment you will need: water in a small cup, a dropper, 2 popsicle sticks, wax paper, 2 large index cards (5"x8"), and tape. You will also need a printed copy of the activity sheet. Follow the instructions on the student activity sheet to complete the experiment. Be certain to answer the questions on the activity sheet. Place your documented experiment at the back of your Chemistry Journal. What connections can you make between this experiment and Kinetic Molecular Theory?

Molecules in Motion: What have you learned about the Kinetic Molecular Theory? How do molecules move? What happens when molecules move at different speeds? Experiment with molecules in motion in this fun activity from ACS Chemistry for Life. For this experiment you will need hot water (about 50 °C) in a clear plastic cup, cold water in a clear plastic cup, yellow food colouring in a small cup, blue food colouring in a small cup, and 4 droppers. You will also need a printed copy of the activity sheet. Follow the instructions on the student activity sheet to complete the experiment. Be certain to answer the questions on the activity sheet. Place your documented experiment at the back of your Chemistry Journal. What connections can you make between this experiment and Kinetic Molecular Theory?

Air, It’s Really There: How do the molecules in air move? Do air molecules move differently when the air is hot compared to when the air is cold? How could you find out?
Experiment with molecules in motion in this fun activity from ACS Chemistry for Life. For this experiment you will need: 2 clear plastic cups, an 8-oz plastic bottle, detergent solution in a cup, hot water (about 50 °C), and cold water. You will also need the activity sheet. Follow the instructions on the student activity sheet to complete the experiment. Be certain to answer the questions on the activity sheet. Place your documented experiment at the back of your Chemistry Journal. What connections can you make between this experiment and Kinetic Molecular Theory?

States of Matter-Molecular Workbench Simulation: Try this fascinating activity from CK-12 (link below). Consider the following: “When a person stands on the floor, his feet exert pressure on the surface. That pressure is related to both the mass of the person and the surface area of his feet. If the person were holding a heavy object, the pressure would increase because of a greater force. Alternatively, if the person stands on his toes, the pressure also increases because of a decrease in the surface area. Gas molecules also exert pressure. Earth’s atmosphere exerts pressure because gravity acts on the huge number of gas particles contained in the atmosphere, holding it in place. Pressure is also exerted by small samples of gas, such as the outward pressure exerted by the gas inside a balloon. Gas pressure is the pressure that results from collisions of gas particles with an object. Inside the balloon, the gas particles collide with the balloon’s inner walls. It is those collisions that keep the balloon inflated. If the gas particles were to suddenly stop moving, the balloon would instantly deflate.”

- To begin, download The Molecular Workbench. Click on “Download MW.” This is a JAVA program that will enable you to perform several different experiments.
- Once you have downloaded the program, click on “browse the entire library.”
- Under the “chemistry” heading, click on “states of matter”.
- Click “gas”.
- Click “run”.
- Click “start compression”.
- Once the compression bar stops, notice where it is positioned. You will be comparing the compression of the gas against the solid and liquid.
- Complete the experiment twice more, once with the solid, and once with the liquid. Each time, note where the compression bar stops.
- Rank the compressibility from least to greatest.
- Now, consider molecular motion. Sketch a quick picture of the way molecules look in a gas, a solid, and a liquid. Why was one phase more easily compressed than the other phases?
Atomic Theory and Models
(Protons, Neutrons, Quarks, Electrons and Leptons)

Books to Read and Talk About:

Atoms and Molecules by Molly Aloian
After reading this book, you will be answering questions in your chemistry journal. A printable journal is available here. If you prefer, you could also answer the questions in a video or audio recording, using a Padlet, or in a word processing program such as Microsoft Word, Pages, or Google Docs. The printable journal also has vocabulary activities that will be helpful to complete prior to beginning the unit.

Investigating the Chemistry of Atoms by Elizabeth Cregan
After reading this book, you will be answering questions in your chemistry journal. A printable journal is available here. If you prefer, you could also answer the questions in a video or audio recording, using a Padlet, or in a word processing program such as Microsoft Word, Pages, or Google Docs. The printable journal also has vocabulary activities that will be helpful to complete prior to beginning the unit.

Videos to Watch and Talk About:

Learn 360:
The Modern Atomic Theory
Atomic Theory
John Dalton’s Atomic Theory of Matter
Atomic Theory and the Periodic Table
Atomic Theory of Matter Part 1
Atomic Theory of Matter Part 2
Atomic Theory: Atoms and Matter
The Dawn of Modern Chemistry: Shedding Light on Atoms
The Discovery of Atoms: Shedding Light on Atoms
Atoms
A Matter of the Atoms: Science Matters
The History of Atomic Theory
Protons, Neutrons, and Electrons: Shedding Light on Atoms
Protons, Neutrons, and Electrons
Atoms, Molecules, and Compounds
Atoms and Elements: Show Me Science
Quarks
Discovery of Protons and Neutrons Part 1
Discovery of Protons and Neutrons Part 2

Activities (Select 3-4):

3D Atom Model: To start, watch Atomic Model from BrainPop. Now, read about Atomic Theory from Khan Academy. Do you know the difference between a scientific law and a scientific theory? They are different, but both very important. To learn more about the difference, watch this fantastic video from TedEd. For this activity you will be creating a 3 dimensional model of an atom. It is important that you use the information in the books you are reading, and information from quality online sources, such as Explora or World Book Student, to help you create models that are as accurate as possible. Your atom should have the following characteristics:

- The correct number of protons
- The correct number of neutrons
- The correct number of electrons
- A nucleus with the correct particle and the correct location within the atom
- An electron cloud with the correct particles and correct location within the atom

Be as creative as you want! You can use all sorts of materials to build your model atom—popsicle sticks, toothpicks, sticky candy, modeling clay, Lego—be creative and have fun! When you are finished your model, label each of the parts and create a chart explaining each part. What are the limitations of using a model to demonstrate the structure of an atom? Do scientists know everything there is to know about atoms? Showcase your model to friends and family members, and ask them for feedback.
The Periodic Table: Everything around us is made of atoms—the entire physical universe is comprised of atoms. Atoms make up elements. Spend some time watching The Periodic Table of Elements from BrainPop. Now, you will be designing an interactive way to explore the periodic table. Your interactive periodic table should contain all 94 naturally occurring elements. Your project should be a way for people to learn the different elements. Consider creating one of the following:

- A board game or card game
- An interactive Padlet, Wix or Weebly
- A song
- A book (try using Storybird)
- A toy that teaches the periodic table
- Artwork
- An educational television show
- A series of cartoons
- A Symbaloo
- Something of your choosing

Have fun and be creative! Consider sharing what you create in the HCOS Ning with other students your age.

Science Power: Complete the Science Power (Worldbook Online) unit on Chemical Elements. Once you have finished the unit, try the Extension Activity and the Experiment.

Investigate a Scientist: For this project you will be investigating a famous scientist who contributed to the field of chemistry. Possibilities include: Marie Curie, Louis Pasteur, Michael Faraday, Alfred Nobel, Rosalind Franklin, Hans Christian Orsted, Albert Hofmann, Irene Joliot-Curie, Henry Cavendish. Use Explora and World Book Student to conduct research into the scientist you have chosen or, you can check out some of the fantastic biographies available in Overdrive such as Women in Science, Michael Faraday's Candle: Burn, or Who Was Albert Einstein?. Then, create a project or presentation about their life and discoveries. This could take the form of:

- A Padlet
- A Wix or Weebly website
Try to make your presentation as engaging as possible. Remember, it is important to create a bibliography to accompany your work. Consider sharing what you create in the HCOS Ning with other students your age.

A Psalm of Praise for Creation: In the Bible, there are many beautiful psalms and songs praising our Creator. The psalmists saw God’s glory all around them, and wanted to praise Him. At the time the psalms were written, humans may not have known about atoms or molecules, but they still recognized the extraordinary complexity of the world God created. The Bible contains the inspired Word of God--there are many truths in the Bible that go far deeper than humanity’s understanding of the world. Spend some time reading Psalm 8, Psalm 19, and Psalm 139. What do they have in common? What do they say about creation? What are your favourite parts of creation? In this unit you are learning about the fascinating building blocks that make up our universe. Each atom has God’s hand in its creation. Use the psalms you read previously as models to create your own psalm. Rather than naming large aspects of creation, for this psalm you will be using the different chemistry-specific things that you have been learning about--atoms, molecules, leptons, electrons, neutrons, quarks, different elements etc.--praise God for the subatomic parts of His extraordinary creation! If you enjoy playing a musical instrument, consider setting your psalm to music. Be certain to share your psalm with others--consider sharing it in the Ning!

Exploring the Physical World: (For this activity you will need chocolate chip cookies--softer is better--homemade is best) What are all of things in the world made of? How do you know? Pick up any item sitting near to you (within reason, if the closest thing to you is a sibling, don’t pick them up without asking permission first). Describe it. How many
different ways can you describe the item? What is it made of? Sitting near me is a wooden ruler. The rule is light. It has numbers on both sides. It has a metal edge pressed into the wood. It makes a swishing noise when I wave it in the air, and a snapping noise when I bang it against my palm. It is made of wood particles that have been pressed together. It has a groove down the center. There are many other things I can say about this ruler, but, when it comes right down to it, this ruler, like everything else in the physical universe, is made of atoms.

Now, get your chocolate chip cookies.

- What is a cookie made of?
- Can you see the different parts of the cookie?
- How do you make a cookie?
- How can you change the flavour of a cookie?
- Does it matter what you use to make a cookie?
- Do all cookie recipes turn out well?

Spend some time separating out the different parts of your chocolate chip cookie. How many parts can it be separated into? Once you have finished playing with your food, grab a piece of paper and write down the parts of the cookie you were able to separate it into. Then, write down all of the different ingredients that went into creating the chocolate chip cookie. Which list has more?

What are the fundamental parts of the chocolate chip cookie? Watch Atoms from BrainPop. What are the fundamental parts of the atom? Spend some time reading about the atom using World Book Student. Then, design an infographic that shares about the atom and breaks it down into fundamental parts. You presentation should:

- Showcase an image of the atom (including representations of protons, neutrons, and electrons)
- Have descriptive information about the atom
- Show a representation of quarks and leptons—and contain information about these parts
- Show how protons are broken into quarks
- Show how neutrons are broken into quarks
- Use an analogy—such as the chocolate chip cookie—to explain the breakdown of the atom. If you would like, try to create your own analogy for atoms!

If you prefer, you could create a poster, digital video, Padlet, Canva brochure, or another product to showcase what you have learned.

The History of the Atom: For this project you will focus on researching the history of the atom and the scientists behind the discoveries and theories related to atoms. You will use the information you gather to create a book or website about the history and
discoveries of the atom! You can use a word processing program, such as Google Docs to create your book, or a presentation software such as PowerPoint. Your book should include pictures. If you prefer, create a website using Wix or Weebly. To start, you will be researching the following scientists: Democritus, Aristotle, John Dalton, J.J. Thomson, Ernest Rutherford, Niels Bohr, Edwin Schrodinger, Albert Einstein, and Werner Heisenberg. Your book or website should also include an overview of the layout of a specific element and the history of that element.

Your book must contain the following sections:

1. Title Page (The History of the Atom and your name)
2. General Information (about the atom, scientists, and elements: definitions, symbols, terms, diagrams etc.)
3. Democritus
4. Aristotle
5. John Dalton
6. J.J. Thomson
7. Ernest Rutherford
8. Niels Bohr
9. Edwin Schrodinger
10. Albert Einstein
11. Werner Heisenberg
12. Information about your element (name of element, symbol, atomic number, atomic mass, when and by whom it was discovered, common uses or reactions that it is used for in daily life, and interesting facts about it.)

For the scientists you should include the following information:

- Name
- Date of discovery (might be approximate)
- Picture of scientist
- Description of experiment they conducted
- Atomic model they determined
- An interesting fact or two and additional picture
- If you choose to create a website, you may want to find a video to include!

You can use Explora and World Book Student to conduct research for your presentation. Explora has an excellent image bank. If you need more images, you can use Google Advanced Images. Always make sure that "safe search" is turned on. Be certain to include a bibliography so that people know where you got your information from.

Build an Atom: For this activity you will be using the computer to build an atom! To start, watch Atoms from BrainPop. Then, visit the PhET simulation. Click the “play”
button on the image to open the simulation. Choose the Atom version. Answer the questions below on paper to include in your Chemistry Journal.

1. Add one proton to the nucleus of the atom (the X). What element did you just create? (It is highlighted on the periodic table to the right of the screen)
2. Add another proton. What element do you have?
3. Keep adding protons. Do you notice any patterns emerging?
4. Next, click on the reset button in the bottom right corner.
5. Add one proton and one neutron to the nucleus (X). Which element did you create?
6. Add another neutron. Which element did you create?
7. What changes when you add a second neutron?
8. Keep adding protons and neutrons to the nucleus. Do you notice any interesting patterns emerging?
9. Now, choose the “Show” menu on the right, add a check mark by clicking the box next to where it says “stable/unstable.” Use at least four protons, and add neutrons and electrons to create a stable atom. What element did you create? How many protons, neutrons, and electrons does the atom have? Why do you think it’s stable?
10. Now try creating an unstable atom. What element did you create? How many protons, neutrons, and electrons does it have? Why do you think it’s unstable?
11. Click on the reset button.
12. Add one proton to the nucleus. Add one electron. What happened?
13. Now, add another electron. What changes?
14. Continue adding electrons. Where are they placed on the atom? How is this different than with the first two electrons?
15. Add various amounts of protons, neutrons, and electrons--explore and have fun! Do you see any more patterns emerging? Can you predict whether an ion is positive or negative?
16. Do you feel you have a better understanding of atoms now that you have completed the simulated experiments? Why or why not?
Bibliography

“AACT Member-Only Content.” TeachChemistry.org, teachchemistry.org/classroom-resources/building-an-atom.

“AACT Member-Only Content.” TeachChemistry.org, teachchemistry.org/classroom-resources/the-scientists-behind-the-atom.


“States of Matter MW Simulation Student.doc.” Google Drive, Google, drive.google.com/file/d/0B_ZuEGrhVEfMMkNmT2tvUWRyUzQ/view.