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SCIENCE 20

Unit A: Chemical Change
Student Guide

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Science 20
Unit A: Chemical Change
ADLC Student Guide

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Science 20 Introduction

This Distance Learning Student Guide is for students who are working on their own through the Science 20 textbook. You will be given information to help you proceed through the textbook and, where necessary, to complete modified activities and investigations.

There are four units in the Science 20 course. Each unit covers a different area of science—Unit A: Chemical Change; Unit B: Changes in Motion; Unit C: The Changing Earth; and Unit D: Changes in Living Systems. The units do not have to be completed in this order. You may want to start with Unit D if you are doing this course in the first semester so that you can do the outdoor activities in warmer weather. If you are doing Science 20 in the second semester, you may want to do Unit D last.

Each unit is made up of a number of chapters. Each chapter has several lessons with information to read, activities and investigations to do, and questions to answer.

General Directions for Students Working Independently

This Science 20 textbook is designed to be used by both non-traditional students and traditional classroom students. If you are a non-traditional student you may need to check with your teacher about not only how to use the Science 20 textbook, but to determine what additional materials or assignments you might need. You may need to complete a distance learning assignment for each chapter of the Science 20 textbook, included within this guide, or your teacher may have other assignments for you to complete and submit for assessment. It is important that you read the information in the textbook and complete the activities, investigations, lesson questions, and as many chapter review questions as you feel are necessary before you complete and submit chapter assignments. Your teacher may assign specific questions for you to complete from the chapter review questions and the unit review questions.

Assessment

Your mark in this course will be based on the assignments you submit, as well as from a midterm exam and a final exam. Check with your teacher for information on how your mark in this course will be assessed.

How to Proceed Through the Science 20 Course

This Distance Learning Student Guide serves as your organizer in Science 20. For each unit of the Science 20 textbook, there is a corresponding section in this guide. Each section provides short introductions to parts of the textbook. After these short introductions are steps marked with check boxes. You will need a notebook in which to write your answers. After you have completed a step, check it off. Then, you will have a record of your progress through the course.

This guide directs you to read from the textbook in manageable portions and then, do the questions. You will check some of the answers on your own. Sample answers will be provided on the Science 20 Textbook CD. Other answers will have to be checked with your teacher. The questions will reinforce your learning and give you a sense of how well you are doing.

The Science 20 course places an emphasis on discovering through hands-on investigations. Such investigations are presented in the Science 20 textbook. Where necessary, this guide will present alternative procedures so that you can work safely at home without having to use a supervised lab facility.

After you complete each lesson, this guide will direct you to complete some questions in your distance learning Assignment Booklet. This written work will be marked by your teacher.

Unit A Chemical Change

How does chemistry affect you? Do you know that many of the items you use every day are the result of some chemical change? The chair you sit on, the paper you write on, the computer you use, and so on all come from natural resources obtained from Earth. Natural resources are transformed into materials that are then manufactured into the products you use.

In this unit, you will investigate chemistry from the point of view of producing consumer goods. These investigations will help you develop an understanding of the nature of matter and chemical change. Throughout this learning you will be encouraged to consider a balance between human needs and the need to maintain a sustainable environment.

❑ Turn to pages 2 and 3 of the textbook and read the Unit A introduction.

Chapter 1: Aqueous Solutions

It is a hot day. You are enjoying a day at the outdoor swimming pool with some friends. Because the pool is outdoors, you know the quantity of chemicals in the water may be a little higher than the quantity found in indoor pools. So, for today, you decide to wear goggles and a swim cap to protect your eyes and hair from the additional chemicals.

A swimming pool is one place where the properties of solutions are dependent on the elements and compounds dissolved in them. In this chapter you will look at the building blocks of matter and explore how they connect with each other. You will study how chemistry is used to produce many of the consumer goods people use today.

❑ Turn to page 4 of the textbook, and read the introduction to Chapter 1.

Observing properties is vital to producing new products. In the next activity you will observe or describe the properties of a number of different substances

Try This Activity: Observing Properties

❑ Read the entire activity on page 5 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the “Suggested Answers” in the online course.

Path 2

❑ Use the sample data for this activity in the "Suggested Answers" in the online course to answer questions 1 and 2 on page 5.

Check your answers with those in the "Suggested Answers" in the online course.

Lesson 1.1: The Structure of Matter

Have you watched the Tour de France or the speed skating events at the Olympics? Did you know that the materials used to make the bicycles, skates, helmets, and clothing are very important to an athlete's success? These materials need to be strong and lightweight. Scientists need to know the elements needed to make these special materials.

To understand how certain materials can be made, you need to understand the basic structure of matter—the atom.

❑ Read pages 6 to 10 of the textbook, ending at the "Diagrams of Atoms and the Periodic Table" activity. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

In the next activity you will use Bohr diagrams and Lewis dot diagrams to explore the properties of elements in the periodic table.

Try This Activity: Diagrams of Atoms and the Periodic Table

❑ **Read the activity on pages 10 and 11 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

When atoms come into close proximity to one another, their electrons are attracted to both nuclei. This attraction results in atomic bonding.

❑ Read pages 12 and 13 of the textbook, ending at "1.1 Summary". Answer Practice questions 7 and 8 on page 13.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "1.1 Summary" on page 13 of the textbook. Then, complete "1.1 Questions" on page 14.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 1.1: The Structure of Matter.

Lesson 1.2: Atomic Bonding and Properties

Did you know that aluminium, salt, and plastic are used in the manufacturing processes of music CDs? These are similar to the substances you observed and described in the "Observing Properties" activity at the beginning of this chapter. These three substances represent three categories of matter: metallic elements, ionic compounds, and molecular compounds.

❑ Read pages 15 to 21 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

The unique properties of each type of matter can be explained using the models you just studied.

❑ Read "Explaining the Properties of Categories of Matter (Extension)" on pages 22 and 23 of the textbook. Then, answer Practice question 12 on page 23.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "1.2 Summary" on page 23 of the textbook. Then, complete "1.2 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 1.2: Atomic Bonding and Properties.

Lesson 1.3: Breaking Bonds

In ancient times, alchemists were unsuccessful in changing base metals, such as lead, into precious metals, like gold. Today, scientists—because of their knowledge of matter—are able to change natural resources into finished products, like plastic bags and clothing. These changes are the result of changing the chemical properties of the materials.

❑ Read pages 24 and 25 of the textbook, ending at the "Water Helps Break Chemical Bonds" activity. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Chemical change is one in which one or more new substances with different properties are formed when substances are mixed. The next activity will demonstrate how water affects chemical change.

Try This Activity: Water Helps Break Chemical Bonds

❑ **Read the entire activity on page 25 of the textbook.**

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ **Follow the directions of the activity, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a teacher demonstration of this activity.

❑ View the segment "Water Helps Break Chemical Bonds" in the "Multimedia Segments" in the online course. Record your observations when prompted.

❑ Answer questions 1 to 4 of "Analysis" on page 25.

Check your answers with those in the "Suggested Answers" in the online course.

Solutions are an excellent medium for chemical change, and water is an ideal solvent.

❑ Read pages 26 to 31 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

In the next investigation, a conductivity meter will be used to check the conductivity of a number of solutions.

Investigation: Aqueous Solutions

- ❑ Read the entire investigation on page 32 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

- ❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

- ❑ Complete steps 1 and 2 of the procedure on page 32.
- ❑ Use the sample data for this investigation in the "Suggested Answers" in the online course to answer questions 1 and 3 of "Analysis" on page 32.

Check your answers with those in the "Suggested Answers" in the online course.

- ❑ Read "1.3 Summary" on page 33 of the textbook. Then, complete "1.3 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 1.3: Breaking Bonds.

Lesson 1.4: Solutions and Concentrations

How many products in the form of a solution (solute dissolved in a solvent) do you use over the course of a day? If you drink fruit juice, use household cleaners, or use hair-care products, you are using a solution. These products require care in manufacture so the solute to solvent ratio is appropriate for the application.

The ratio of the quantity of solute to the quantity of solution is the concentration of the solution. Solutions can be dilute or concentrated.

- ❑ Read pages 34 and 35 of the textbook. Then, answer Practice questions 25 and 26.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "Observing the Effects of Reduced Concentrations" at the top of page 36 of the textbook.

In the next investigation you will observe the effects of concentration on a chemical reaction.

Investigation: Repeated Dilutions

❑ **Read the entire investigation on pages 36 and 37 of the textbook.**

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ **Follow the directions of the investigation, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you can use grape drink crystals and water to produce a brightly coloured solution. (Any brightly coloured drink crystals can be used.) Use nine plastic glasses in place of the 100-mL beakers. Start with a full glass of water and add about 20 mL (2 teaspoons) of drink crystals. Follow steps 3 to 5 of the procedure on page 36 of the textbook to dilute this solution into the remaining glasses. Compare the colour of the solution in each glass. This will give you an idea of how dilution affects the concentration of a solution.

❑ **Answer questions 1, 2, 3, and 5 of "Analysis" as if you had performed the original investigation with the sodium hydroxide and phenolphthalein.**

Check your answers with those in the "Suggested Answers" in the online course.

Determining which solution is more concentrated can be done in several ways. Often, a qualitative analysis (using your senses to observe a solution) can determine relative concentrations of solutions.

❑ Read pages 37 and 38 of the textbook and "Concentration Affects the Speed of Chemical Reactions" at the top of page 39. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "1.4 Summary" on page 39 of the textbook. Then, complete "1.4 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 1.4: Solutions and Concentrations.

Lesson 1.5: Calculating Concentration

Determining concentration qualitatively can give you an idea of the relative concentration of a number of solutions. However, to determine the actual concentration of a solution, accurate measurements of amounts of solute and solvent have to be made.

❑ Read pages 40 to 46 of the textbook, ending at the investigation. Pay particular attention to the example problems, and answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

In the next investigation you will observe and practise the skills used for making a standard solution and a dilute solution.

Investigation: Developing Technological Skills with Solutions

❑ Read the entire investigation on pages 46 to 48 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, Path 2.

Path 1

❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a lab technician use a pipette and volumetric flask to dilute a previously prepared solution of cobalt(II) nitrate. The concentration involved and the substance are not the same as those in the investigation, but the techniques are the same.

❑ Complete questions 1 and 2 of "Pre-Lab Analysis" on page 47.

❑ View the segment "Diluting the Solution" in the "Multimedia Segments" in the online course and answer questions 3 to 8 on page 48.

Check your answers with those in the "Suggested Answers" in the online course.

Solutions are often shipped in concentrated form to save shipping costs. If you need a solution of a particular concentration, you add distilled water to a calculated volume of concentrate.

❑ Read pages 48 to 51 of the textbook, starting at “Diluting Solutions” and ending at “1.5 Summary”. Carefully work through Example Problem 1.13, and answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

❑ Read “1.5 Summary” on page 51 of the textbook. Then, complete “1.5 Questions” on page 52.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

❑ Go to Assignment 1.5: Calculating Concentration.

Chapter 1 Summary

❑ Read “Chapter 1 Summary” on page 53 of the textbook. Remember to use one of the given options to make your own summary of the key concepts and important chapter terms.

❑ Turn to “Chapter 1 Review Questions” on pages 54 to 57 of the textbook. Do questions 1, 2, 4, 6, 7, and 9. Then, do as many of the remaining questions as you feel are necessary to understand the concepts covered in this chapter.

Check your answers with those in the “Suggested Answers” in the online course.

Chapter 2: The Reduction and Oxidation of Metals

Have you ever seen a beautifully restored, older car? The car may have been rusting behind the front and rear fenders and on the bumpers where the chrome has flaked off. But the car can be made to look like new by cutting and replacing parts of the fenders and by chemically cleaning and adding a new layer of chrome to the bumpers.

In this chapter, you will discover how metals are mined and examine some of the chemical processes that involve metals.

❑ Turn to page 58 of the textbook, and read the introduction to Chapter 2.

The reactivity of metals can often be readily observed. In the next activity you will observe the reactivity of zinc metal when a drop or two of silver nitrate solution is placed on the metal.

Investigation

❑ Read the entire activity on page 59 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a slide show demonstrating this activity.

❑ View the segment "Observing the Reactivity of Zinc" in the "Multimedia Segments" in the online course. Follow the directions when prompted.

❑ Answer questions 1 to 6 of "Analysis" on page 59.

Check your answers with those in the "Suggested Answers" in the online course.

Lesson 2.1: Compounds and Chemical Change

Most metals tarnish. In this process, a chemical change occurs between the metal and some other substance or substances so that some of the metal combines with the tarnishing substance. Balanced chemical equations and mole ratios can be used to determine the amount of metal involved in the chemical change.

❑ Read pages 60 to 65 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

You can use mole ratio to determine the number of moles of a product produced in a chemical reaction. In the next investigation you will determine the number of moles of a product. You will then compare this value to the theoretical number of moles of the product determined from the equation.

Investigation: Mole Ratios in Chemical Reactions

❑ Read the entire investigation on pages 66 and 67 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

❑ Complete questions 1 to 5 of "Pre-Lab Analysis".

❑ Use the sample data for this investigation in the "Suggested Answers" in the online course to complete the table and to answer questions 6 to 10 on page 67. For questions 9 and 10, theorize some of the difficulties that may have been encountered.

Check your answers with those in the "Suggested Answers" in the online course.

The previous investigation showed the importance of mole ratios in calculating the amount of an unknown substance involved in a chemical reaction. The calculations end up following a similar pattern. That's what makes the calculations suitable for automation. In the next investigation, you will design an automatic mole calculator.

Utilizing Technology: Building an Automatic Mole Calculator Spreadsheet

- ❑ Read the activity on page 67 of the textbook. Follow the directions to create your own automatic mole calculator.

Check your answers with those in the "Suggested Answers" in the online course.

- ❑ Read "Using Chemistry to Preserve Artifacts" on page 68 of the textbook.
- ❑ Read "2.1 Summary" on page 68 of the textbook. Then, complete "2.1 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 2.1: Compounds and Chemical Change.

Lesson 2.2: The Gain and Loss of Electrons

Check the water pipes in your home. Are they made of copper? Although water pipes may be made of plastic these days, copper has traditionally been used for water pipes as well as for electrical wire.

- ❑ Read pages 69 to 71 of the textbook, ending at "The Transfer of Electrons". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Metals are usually found in ionic compounds in ore deposits. This is because most metals readily combine with many non-metal substances when electrons are transferred. Oxidation and reduction are two chemical processes involving the transfer of electrons.

- ❑ Starting at "The Transfer of Electrons" on page 71 of the textbook, read up to "2.2 Summary" on page 75. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "2.2 Summary" on page 75 of the textbook. Then, complete "2.2 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.2: The Gain and Loss of Electrons.

Lesson 2.3: The Reactivity of Metals

In Lesson 2.2, you learned that many metals or their corresponding ions readily react with non-metal substances. Not all metals readily react with non-metal substances—gold is an example of this kind of metal substance.

❑ Read pages 76 and 77 of the textbook up to "Investigating the Reactivity of Metals". Answer Practice questions 22 and 23.

Check your answers with those in the "Practice Answers" in the online course.

Most metals are more reactive than gold. Reading this statement may prompt you to ask, how can you compare the reactivity of metals? One way to compare the reactivity of metals is to set up a competition.

❑ Read "Investigating the Reactivity of Metals" at the bottom of page 77 of the textbook.

Investigation: Ranking the Reactivity of Metal Ions

❑ Read the entire investigation on page 78 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

❑ Use the sample data for this investigation in the "Suggested Answers" in the online course to answer questions 1 to 4 of "Analysis" on page 78.

Check your answers with those in the "Suggested Answers" in the online course.

In the previous investigation, you discovered that metals and metal ions vary in their reactivity with non-metals. Metals and their corresponding ions are arranged according to their reactivity in an activity series.

❑ Read pages 79 to 83 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

The activity series was produced by performing experiments that test the position of various metals and their ions relative to one of the metals. In the next activity you will design an experiment that will allow you to determine the position of metals above and below hydrogen.

Investigation: Planning an Experiment Using the Activity Series

❑ **Read the investigation on page 84 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Gold has been of great importance in the making of jewellery throughout history. Now, gold is also valuable in manufacturing personal computers.

❑ Read "Gold—From Jewellery to High Technology" on page 84 of the textbook and "Did You Know?" on page 85.

❑ Read "2.3 Summary" on page 85 of the textbook. Then, complete "2.3 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.3: The Reactivity of Metals.

Lesson 2.4: Using Voltaic Cells

Voltaic cells make use of the oxidation and reduction reactions of metals and metal ions. You are familiar with voltaic cells in the form of batteries.

❑ Read pages 86 and 87 of the textbook up to the investigation. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

As in the following investigation, you can build a simple voltaic cell by using metal strips and their corresponding metal-sulfate solutions.

Investigation: Building a Voltaic Cell

❑ Read the entire investigation on pages 87 to 89 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a slide show that will show you how to build a voltaic cell.

❑ Complete the pre-lab analysis on page 88.

❑ View the segment "Building a Voltaic Cell" in the "Multimedia Segments" in the online course. Record your observations when prompted.

❑ Answer questions 8 to 11 of "Analysis" on page 89.

Check your answers with those in the "Suggested Answers" in the online course.

How does a voltaic cell work? In Lesson 2.3 you investigated the activity series for metals and metal ions. The chart also described oxidation and reduction reactions. A voltaic cell uses oxidation and reduction reactions to transform chemical energy into electrical energy.

❑ Read pages 89 to 92, starting with "Analyzing How a Voltaic Cell Works". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Voltaic cells can be built using different combinations of metals and solutions containing metal ions. In the next investigation you will design a number of voltaic cells based on the desired output on a voltmeter.

Investigation: Designing Voltaic Cells

❑ **Read the investigation on page 93 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Although voltaic cells that use two metals strips and two beakers of solutions containing metal ions do work, such an apparatus is not practical for use in everyday applications. You need a voltaic cell in a package that's convenient and easy to handle. These are the dry cells that you buy for your digital camera or MP3 player.

❑ Read "Voltaic Cells for Consumer Use" on page 93 of the textbook. Then, answer the Practice questions 42 and 43 on page 94.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "2.4 Summary" on page 94 of the textbook. Then, complete "2.4 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.4: Using Voltaic Cells.

Lesson 2.5: The Electrolytic Cell

A voltaic cell uses chemical energy to produce electricity. In contrast, an electrolytic cell uses electrical energy to produce a chemical change.

❑ Read page 95 of the textbook.

A simple electrolytic cell can be observed in the next activity.

Try This Activity: Using Electrical Energy to Force Chemical Change

❑ Read the entire activity on page 96 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

❑ View the segment "Using Electrical Energy to Force Chemical Change" in the "Multimedia Segments" in the online course.

❑ Answer questions 1 and 4 of "Analysis" on page 96.

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read "Using Electrical Energy to Produce Metal Coatings" on page 97 of the textbook.

In the next investigation you can build an electrolytic cell that will electroplate copper onto a carbon electrode.

Investigation: Electroplating Copper

❑ Read the entire investigation on pages 97 and 98 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a slide show demonstrating this investigation.

- ❑ View the segment "Electroplating Copper" in the "Multimedia Segments" in the online course. Record the mass of each electrode at both the start and the end when prompted.
- ❑ Answer questions 1 to 5 of "Analysis" on page 98.

Check your answers with those in the "Suggested Answers" in the online course.

Electroplating is a process that forces non-spontaneous oxidation and reduction reactions to occur. Energy from a battery or electrical apparatus is used to remove electrons from the metal located at the anode and transfer them to the metal ions within the electrolyte near the cathode. Electroplating is used to deposit a thin layer of desirable metal on a base metal, to refine metals, and to purify non-metals.

- ❑ Read pages 98 to 100 of the textbook, starting with "A Look into Electroplating—The Mechanics of an Electrolytic Cell". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "2.5 Summary" on page 101 of the textbook. Then complete "2.5 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 2.5: The Electrolytic Cell.

Chapter 2 Summary

- ❑ Read "Chapter 2 Summary" on page 102 of the textbook. Remember to use one of the given options to make your own summary of the key concepts and important chapter terms.
- ❑ Turn to "Chapter 2 Review Questions" on pages 103 to 105 of the textbook. Do questions 1, 3, 5, 7, 9, 10, 11, 12, 13, 15, and 17. Then do as many of the remaining questions as you feel are necessary to understand the concepts covered in this chapter.

Check your answers with those in the "Suggested Answers" in the online course.

Chapter 3: Organic Chemistry

When you hear about oil, do you think about fuel for cars, trucks, and farm machinery? The petroleum industry involves much more than just fuel. Petroleum is actually used for a variety of carbon-based compounds, such as plastics, cosmetics, medicines, and even some food products.

❑ Turn to page 106 of the textbook, and read the introduction to Chapter 3.

From petroleum—a gooey, dirty-looking liquid—come so many useful substances with unique and useful properties. Chemical transformations are involved in making these useful substances. In the next activity you will discover one such transformation.

Try This Activity: Making an Organic Compound

❑ Read the entire activity on page 107 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch a student carry out this activity.

❑ View the segment "Making an Organic Compound" in the "Multimedia Segments" in the online course. Record your observations when prompted.

❑ Use what you observed in the segment to complete the table on page 107.

Check your answers with those in the "Suggested Answers" in the online course.

Lesson 3.1: Carbon Chains

Carbon is an important building block of both living and non-living things on Earth. Many of the items you see around you and even your body itself are made up of carbon-based compounds. These consist of carbon chains of various lengths. The compound properties depend on the number of carbon atoms within the chain. The study of compounds composed of carbon is known as organic chemistry.

❑ Read pages 108 to 110 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Hydrocarbons are the simplest carbon compounds. As the name implies, these compounds contain carbon and hydrogen. The simplest hydrocarbons are alkanes; they contain only single bonds between atoms.

❑ Read pages 111 to 113 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Alkanes are named using prefixes to indicate the number of carbon atoms in the chain and using the suffix *-ane* to indicate that this family of compounds has only single bonds.

❑ Read pages 114 and 115 of the textbook. Then, answer Practice questions 9 to 14 on page 116.

Check your answers with those in the "Practice Answers" in the online course.

Not all alkanes contain straight chains. Alkanes that contain a number of short chains attached to a parent chain are called branched alkanes. These can become quite complex. Each new branch attached to the parent chain gives the compound its own set of properties.

❑ Read pages 116 to 120 of the textbook. Start at "Branched Alkanes" and end at "3.1 Summary". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "3.1 Summary" on page 120 of the textbook. Then, complete "3.1 Questions" on page 121.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 3.1: Carbon Chains.

Lesson 3.2: Saturated and Unsaturated Hydrocarbons

Do you pay attention to the nutritional facts listed on food packages? Most of these packages list grams of fat, grams of carbohydrates, milligrams of vitamin B, and so on. Grams of fat are often separated into saturated fat and unsaturated fat.

Hydrocarbons that contain only single bonds are saturated hydrocarbons. Those that contain double or triple bonds are unsaturated hydrocarbons.

❑ Read pages 122 to 125 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

A molecular model kit is used to make models of the different hydrocarbons. A three-dimensional model helps you visualize how atoms are connected.

Try This Activity: Building Models of Hydrocarbons

❑ Read the entire activity on page 126 of the textbook.

If you have access to a molecular model kit, do Path 1. If you do not have access to a molecular model kit, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will view an applet that will provide pictures of molecular models of hydrocarbons.

❑ View the applet "Building Models of Hydrocarbons" in the "Multimedia Segments" in the online course..

❑ Use the applet to complete steps 1 and 3 of the procedure and to answer questions 1 to 3 of "Analysis" on page 126.

Check your answers with those in the "Suggested Answers" in the online course.

A compound that has at least one double bond is called an alkene. An alkyne is a compound that has at least one triple bond.

- ❑ Read pages 127 and 128 of the textbook. Then, answer Practice questions 27 to 30 on page 129.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "Saturated and Unsaturated Compounds in Food" at the top of page 130 of the textbook.

In the next investigation you have the opportunity to determine if there is a relationship between different groups of hydrocarbons and their chemical structure.

Investigation: Connecting Chemical and Physical Properties to Structure

- ❑ Read the entire investigation on page 130 of the textbook.

If you have access to a molecular model kit, do Path 1. If you do not have access to a molecular model kit, do Path 2.

Path 1

- ❑ Follow the directions of the investigation, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will use an applet to examine the molecular models of the molecules given in step 2 of the procedure on page 130.

- ❑ View the applet "Connecting Chemical and Physical Properties to Structure" in the "Multimedia Segments" in the online course.
- ❑ Use the applet to study the structure of the three types of hydrocarbons and to think about how the structure might relate to the properties of each hydrocarbon.
- ❑ Complete questions 1 to 11 of "Analysis" on page 130 of the textbook.

Check your answers with those in the "Suggested Answers" in the online course.

In the next activity, you will analyze how boiling points vary with different types of hydrocarbons.

Try This Activity: Investigating Hydrocarbon Boiling Points

❑ Read the activity on page 131 of the textbook. Follow the directions, and answer the questions.

Note: A spreadsheet may be very useful.

Check your answers with those in the "Suggested Answers" in the online course.

You should have discovered in the activity that melting points and boiling points of hydrocarbons are related to the number of carbon atoms in the molecule. The reactivity of hydrocarbons is affected by the number of carbon-carbon bonds. Unsaturated hydrocarbons are more reactive than saturated hydrocarbons.

❑ Read page 132 of the textbook. Then, answer Practice question 34 at the top of page 133.

Check your answers with those in the "Practice Answers" in the online course.

Check a margarine container. It will likely say "Contains No Trans Fats" or "Less Than 3% Trans Fats". Trans fats or trans fatty acids are produced in margarine when hydrogen gas is bubbled through hot vegetable oil. Scientists have developed numerous processes to synthesize hydrocarbons—some of these are used in the food industry.

❑ Read pages 133 to 135 of the textbook. Start with "The Origins of Industrially Produced Trans Fatty Acids" and end at "3.2 Summary". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "3.2 Summary" on page 135 of the textbook. Then complete "3.2 Questions" on page 136.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 3.2: Saturated and Unsaturated Hydrocarbons.

Lesson 3.3: Petroleum Is the Source

Petroleum is the source for a numbers of hydrocarbons used to produce consumer goods.

❑ Read pages 137 and 138 of the textbook, ending at the "Separating Components of a Mixture" activity. You can separate components if they have unique physical or chemical properties.

Try This Activity: Separating Components of a Mixture

❑ Read the entire activity on page 138 of the textbook.

If you have access to a supervised laboratory, do Path 1. If you do not have access to a supervised laboratory, do Path 2.

Path 1

❑ Follow the directions of the activity, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

❑ Use your knowledge of the properties of each component of the mixture to answer questions 1 to 3 of "Analysis" on page 138.

Check your answers with those in the "Suggested Answers" in the online course.

Petroleum is used to produce a large variety of hydrocarbons through processes that involve fractional distillation and refining. Because each hydrocarbon has its own boiling point, heat can be used to separate petroleum into its components.

❑ Read "Separating Petroleum into Its Fractions" on page 138 of the textbook.

Utilizing Technology: From Petroleum to Gasoline

❑ Read the activity on page 139 of the textbook. Follow the directions, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

Many hydrocarbons require more than just fractional distillation to become usable products.

❑ Read pages 140 to 142 of the textbook, ending at the “Get Cracking” activity. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

Cracking long-chain molecules can produce more than one combination of products.

Try This Activity: Get Cracking

❑ Read the activity on page 142 of the textbook. Follow the directions, and answer the questions.

Check your answers with those in the “Suggested Answers” in the online course.

❑ Read “Cracking Is a Random Reaction” on page 143 of the textbook.

❑ Read “3.3 Summary” on page 143 of the textbook. Then complete “3.3 Questions”.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

❑ Go to Assignment 3.3: Petroleum Is the Source.

Lesson 3.4: Everyday Use of Hydrocarbons

Throughout history, names have been given to different periods due to a major commodity used during that period. You are currently living in the Hydrocarbon Age.

❑ Read pages 144 to 146 of the textbook, ending at “Comparing Combustion Reactions”. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

Combustion reactions use oxygen and produce carbon dioxide. This production of carbon dioxide is having a profound effect on the environment.

❑ Read pages 146 to 148 of the textbook. Start at “Comparing Combustion Reactions” and end at the “Voluntarily Reducing Hydrocarbon Consumption” activity. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

What can you do to reduce the use of gasoline? If your family reduces its gasoline use by 10%, that may not seem very significant. However, when multiplied by the amount of gasoline used in one community or one province, the reduction will be very significant.

Try This Activity: Voluntarily Reducing Hydrocarbon Consumption

❑ Read the activity on page 148 of the textbook. Follow the directions, and answer the questions.

Check your answers with those in the “Suggested Answers” in the online course.

Plastics are produced from hydrocarbons. Many short, unsaturated hydrocarbon molecules are joined together to form long carbon chains known as plastics. This process is called polymerization, and the resulting product is a polymer.

❑ Read pages 149 to 151 of the textbook, ending at “3.4 Summary”. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

❑ Read “3.4 Summary” on page 151 of the textbook. Then, complete “3.4 Questions”.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

❑ Go to Assignment 3.4: Everyday Use of Hydrocarbons.

Chapter 3 Summary

- ❑ Read "Chapter 3 Summary" on page 152 of the textbook. Remember to use one of the given options to make your own summary of the key concepts and important chapter terms.

- ❑ Turn to "Chapter 3 Review Questions" on pages 153 to 155 of the textbook. Do questions 2, 4, 6, 8, and 10 to 15. Then do as many of the remaining questions as you feel are necessary to understand the concepts covered in this chapter.

Check your answers with those in the "Suggested Answers" in the online course.

Unit A Conclusion

- ❑ Read the Unit A conclusion, including "Career Profile: Metallurgical Engineer," on page 156 of the textbook.

- ❑ Turn to "Unit A Review Questions" on pages 157 to 163 of the textbook. Do questions 4, 8, 12, 14 to 18, 20, 24, 27, 28, 32, and 36. Then do as many of the remaining questions as you feel are necessary to understand the concepts covered in this unit.

Check your answers with those in the "Suggested Answers" in the online course.

Assignment

- ❑ Go to the Unit A Review Assignment, and answer all the review questions. Be sure to submit your completed assignment.

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