

Adult Basic Education
Science

Science 3101

Matter and Chemical Change

Curriculum Guide

Prerequisites: None

Credit Value: 1

Science Courses [General College Profile]

Science 2100A

Science 2100B

Science 2100C

Science 3101

Science 3102

Science 3103

Science 3104

Science 3105

Science 3106

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To the Instructor

I. Introduction to Science 3101

Science 3101, *Matter and Chemical Change*, introduces students to chemicals and chemical reactions and the role that they play in daily life.

The course begins with a discussion of ways that chemicals are useful and how to use them safely. Students are introduced to two chemical information safety systems. They learn about states and properties of matter and how to tell the difference between a pure substance and a mixture.

In Unit 2, students investigate pure substances, elements and compounds. They learn their way around the periodic table and become familiar with names and formulas for some common elements and simple compounds.

In Unit 3, students investigate mixtures. They learn the difference between solutions and mechanical mixtures. They investigate concentration and solubility and are introduced to acids, bases and the pH scale.

In Unit 4, students take a closer look at some everyday chemical reactions. They investigate how substances change during a reaction and how energy is involved in every chemical reaction. They are introduced to the use of word equations to represent chemical reactions. They finish the course by applying the knowledge that they have gained to investigate acid deposition.

Students are required to complete three **Assignments** in this course. However, there are many topics included in this course that students may be interested in exploring further. They could be given additional assignments or the opportunity to investigate topics in group work. Coordination with the English program is possible in assigning and evaluating additional work. Instructors should note that the material covered in the required assignments is **not** intended for testing.

Students are required to complete three **Core Labs** in this course. Additional laboratory investigations may be added.

Note:

Students cannot get credit for Science 3101 if they have previously received credit for either Science 1206 in high school or Chemistry 1102 in ABE.

To the Instructor

II. Curriculum Guide

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

**Curriculum Guide Organization:
The Two-Page, Four-Column Spread**

| | | | |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Unit Number - Unit Title | | Unit Number - Unit Title | |
| Outcomes Specific curriculum outcomes for the unit. | Notes for Teaching and Learning Suggested activities, elaboration of outcomes, and background information. | Suggestions for Assessment Suggestions for assessing students' achievement of outcomes. | Resources Authorized and recommended resources that address outcomes. |

III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

To the Instructor

IV. Resources

Essential Resources

science.connect1; Colbourne, Fernandez, et al; McGraw-Hill Ryerson; 2002.
ISBN: 0070890927 (Includes Student Multimedia CD-ROM.)

science.connect.2; Colbourne, Fehres, et al; McGraw-Hill Ryerson; 2003.
ISBN: 0070890943 (Includes Student Multimedia CD-ROM.)

science.connect1 Teacher's Resource, Unit C.

science.connect2 Teacher's Resource, Unit C.

Laboratory Supplies and Equipment.

Recommended Resources

science.connect1 web site:

<http://www.mcgrawhill.ca/school/booksites/science.connect+1/>

science.connect2 web site:

<http://www.mcgrawhill.ca/school/booksites/science.connect+2/>

Computer with CD-ROM and Internet connection

Note: In addition to the text, this course is designed to make use of multimedia, in the form of CD-ROM and the Internet, to help reinforce important concepts. **Disc Connects** refer to the use of the CD-ROM that accompanies the text. It uses interactive methods that most students will find interesting and useful. **Internet Connects** (ICTs) refer to the use of internet sites to assist in learning about topics covered in the course. ICT Masters are provided in the Teacher's Resource or at the text web site to assist in identifying important information.

To the Instructor

V. Recommended Evaluation

| | |
|-------------------------------------|------------|
| Written Notes | 10% |
| Labs/Assignments | 20% |
| Test(s) | 20% |
| Final Exam (<i>entire course</i>) | <u>50%</u> |
| | 100% |

Matter and Chemical Change

Unit 1 - Matter

Outcomes

1.1 Describe safety precautions that should be followed when handling, storing, and disposing of substances at home and in the laboratory.

1.1.1 Identify hazardous chemicals used at home and at work.

1.1.2 Explain how WHMIS and HHPS systems safely communicate information about substances.

1.1.3 Recognize the potential dangers of using chemicals.

1.2 Classify various forms of matter based on their properties.

1.2.1 Define matter.

1.2.2 Describe the particle theory of matter.

1.2.3 Apply the particle model of matter to explain the physical properties of the phases of matter.

1.2.4 Differentiate between physical and chemical properties of matter.

1.2.5 Differentiate between mixtures and pure substances.

Notes for Teaching and Learning

Many students will be familiar with the concepts covered in this unit, especially if they have recently completed IS2013, Matter, in Level II.. Therefore, these students should be able to move quickly through this unit with little difficulty.

Instructors could have students do the Starting Point Activity, *When Substances React*, on page 5 to demonstrate how mixing chemicals may have unknown consequences. Refer to the *Teacher's Resource* for information about this activity.

Students are introduced to WHMIS and HHPS in this unit by completing the **Assignment** and the **Computer** sections at the beginning of the Study Guide. They should be aware of these and know what they are used for, but they do not need to memorize the symbols used.

Students are directed to complete the **Disc Connect** *WHMIS* applet as part of the assignment.

Note: It is suggested that instructors have the CD-ROM installed on a server or on individual computers and that the computers the students will be using are connected to a printer.

Note: Blackline Masters (BLMs) and answers to all the BLMs are found in the *Teacher's Resource*.

Unit 1 - Matter

Suggestions for Assessment

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course. (**Note:** An overall mark of 10% is recommended for the written work from the Study Guide, excluding lab reports and assignments. An overall mark of 20% is recommended for the labs and assignments.)

The assignment (including the **WHMIS Symbol Table** and the **Certificate of Completion** printed out from the computer section) should be marked and the mark obtained should be used as a portion of the final mark for the course. Students **should not** be tested on the material covered in the assignment. BLMs 1-2, 1-3, and 1-4 are included in the Appendix of the Study Guide and are needed for the assignment.

Students will be introduced to many new terms throughout this course. Instructors could suggest that students start a vocabulary list and add to it regularly as they work through the unit. The glossary can be used to provide definitions.

BLM 1-6 could be used as review and reinforcement of physical and chemical properties.

Investigation 1-B, *Classifying Matter*, and/or Investigation 1-C, *Melting and Boiling Points*, may be completed. The Teacher's Resource provides information for both these investigations.

BLM 1-10 is a good review of how to measure volume, mass, and temperature.

Students may be assigned additional questions from the *Check Your Understanding* at the end of each section of the text or from the *Review* at the end of the chapter.

BLM 1-14 can be used for review and reinforcement.

Resources

science.connect1,
Chapter 1, pages 4 - 19.

science.connect1, CD-ROM.

science.connect1
Teacher's Resource, Unit A.

science.connect1 web site:
<http://www.mcgrawhill.ca/school/booksites/science.connect+1/>

BLM 1-2, *Safety Symbol Inventory*.

BLM 1-3, *Sample WHMIS Label*.

BLM 1-4, *Sample MSDS*.

BLM 1-6, *Chemical and Physical Properties*.

BLM 1-10, *Measuring*.

BLM 1-14, *Classification of Matter Crossword*.

Unit 2 - Elements and Compounds

Outcomes

2.1 Use the periodic table to identify trends in the properties of elements.

2.1.1 Define element.

2.1.2 Identify atoms as the smallest unit of matter.

2.1.3 Use the periodic table to locate names, symbols, and properties of elements.

2.1.4 Distinguish between groups and periods in the periodic table.

2.1.5 Differentiate between metals, non-metals, and metalloids on the basis of properties.

2.2 Explore the relationship between elements and compounds.

2.2.1 Classify pure substances as either elements or compounds.

2.2.2 Name and write chemical formulas for common compounds.

2.2.3 Demonstrate the separation of an element from a compound in a decomposition reaction.

Notes for Teaching and Learning

Students are required to work through the **Disc Connect**, *Periodic Table*, to learn more about how chemical elements are classified and to compare the physical properties of metal and non-metal elements. They should be provided with a copy of ICT 2-2 to complete as they work on the computer. They will print out a copy of the **Certificate of Completion** to be included with their notes.

Students could be asked to complete Investigation 2-B, *Properties of Metals and Non-metals*, to help in identifying common properties. A sample data chart and other information is provided in the *Teacher's Resource*.

BLM 1-9 could be copied and given to students or used as an overhead to summarize the classification of matter.

BLM 2-5 can be copied and given to students or used as an overhead to reinforce the information provided in the periodic table about elements. Note that the (aq) designation is not used in this text.

Students are directed in the Study Guide to complete the Find Out Activity, *Interpreting Chemical Formulas*, on page 37 of the text. BLM 2-6 contains a blank chart and question blanks that can be used for this activity.

Unit 2 - Elements and Compounds

Suggestions for Assessment

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

Students are required to complete **Core Lab #1, Decomposition Reaction**. BLM 2-4 should be provided to students to use as a lab report. Instructors should refer to the Teacher's Resource for information about the lab and for the answers to the questions.

Students may be assigned additional questions from the *Check Your Understanding* at the end of each section of the text or from the *Review* at the end of the chapter.

BLM 2-7 can be used for review and reinforcement.

Instructors may give a test at the end of Unit 2 to include material covered in the first 2 units. BLMs 1-15 and 2-9 can be used to provide some questions for the test. The mark for the test would be used as part of the final mark for the course.

Resources

science.connect1, Chapter 2, pages 22 - 37.

science.connect1, CD-ROM.

Core Lab #1:
Decomposition Reaction, page 32.

BLM 2-4, *Conduct an Investigation 2-C Worksheet*.

BLM 2-5, *What's in a Formula?*

BLM 2-6, *Interpreting Chemical Formulas*.

BLM 2-7, *Pure Substances Crossword*.

BLM 1-9, *Classification of Matter Flowchart*.

BLM 1-15, *Chapter 1 Chapter Test*.

BLM 2-9, *Chapter 2 Chapter Test*.

Unit 3 - Mixtures

Outcomes

- 3.1 Describe solutions.
 - 3.1.1 Distinguish between mechanical mixtures and solutions.
 - 3.1.2 Define operationally, solute and solvent.
 - 3.1.3 Identify the solute and solvent in a solution.
 - 3.1.4 Distinguish between concentrated and dilute solutions.
- 3.2 Describe solubility.
 - 3.2.1 Define operationally, solubility, and identify soluble and insoluble substances.
 - 3.2.2 Define concentration and express concentration in terms of mass per volume.
 - 3.2.3 Explain the effect of temperature change on solubility.
- 3.3 Identify acid and base solutions on the basis of their properties.
 - 3.3.1 Define operationally, acid, base and neutral.

Notes for Teaching and Learning

Students may be familiar with many of the concepts in this unit, especially if they have recently completed the Level II course, IS2013, Matter.

BLM 1-9, which was suggested for unit 2, could be used again here to reinforce classification of matter.

Students could do the Find Out Activity, *What Kind of Mixture?*, on page 44, to help them understand the difference between solutions and mechanical mixtures. BLM 3-1 could be used to record their observations and answer questions.

Students are given an introduction to acids and bases in this unit. These concepts are covered in sections 4.1 and 4.2 of the text.

Unit 3 - Mixtures

Suggestions for Assessment

Instructors should review all the student answers to the questions in the *Study Guide* for this unit. Their written work should be assigned a mark to be used as part of the final evaluation for the course.

Students are required to complete the **Core Lab**, *What is the Best Solvent?*. BLM 3-5 should be provided to students to record their observations and may be used as a lab report. Instructors should refer to the Teacher's Resource for information about the lab and for the answers to the questions.

Students could be asked to complete the Find Out Activity, *Concentrations of Consumer Products*, page 45, to examine the properties of various consumer products. BLM 3-3 can be used to record observations and answer questions.

Students are not required to complete Investigation 3-A. However, if time permits, this would be a useful activity to allow students to examine data to support the theory that temperature increases solubility. This is a good opportunity for students to get practice in drawing and interpreting line graphs. Those with experience or an aptitude for computers could be encouraged to use a spreadsheet program to do the graph (See BLM 1-12 to assist).

Resources

science.connect1,
Chapter 3, Sections 3.1 -
3.3; pages 40 - 49.

science.connect1,
Chapter 4, Section 4.1,
page 60; Section 4.2;
pages 63 - 69.

Core Lab #2:

What is the Best Solvent?,
page 48.

BLM 3-1, *What Kind of
Mixture?*

BLM 3-3, *Concentrations
of Consumer Products.*

BLM 3-5, *Conduct an
Investigation 3-B
Worksheet.*

Unit 3 - Mixtures

Outcomes

3.3.2 Describe, in general terms, the pH scale as an indicator of acidity or basicity.

3.3.3 Investigate the pH of common substances.

Notes for Teaching and Learning

Students are required to work through the **Disc Connect**, *Acids and Bases*, where they do a laboratory simulation that runs a series of tests on household items to determine which are acids and which are bases. They should be provided with a copy of ICT 4-3 to complete as they work on the computer. They will print out a copy of the **Certificate of Completion** to be included with their notes.

Students can have the opportunity to gain hands on experience in identifying common household mixtures as acids and bases and determining their pH by completing Investigation 4-B, *Acids and Bases Around You*, pages 66 - 68. BLM 4-5 can be used to record observations.

For hands on experience in seeing how pH and conductivity are related, students could also be asked to complete the activity outlined on BLM 4-4, *Conductivity and pH*.

Students should understand that small changes in pH value indicate very large changes in level of acidity (i.e., pH scale is logarithmic). Therefore each decrease of 1.0 on the pH scale means a ten-fold increase in the amount of acid present. For example, a solution with pH=3 is 10 times more acidic than one that is pH=4 and 100 times more acidic than one that is pH=5.

Unit 3 - Mixtures

Suggestions for Assessment

If students were not tested at the end of the second unit, they should be given a test at the end of Unit 3 to cover the first 3 units of the course. BLM 4-9, could be used to provide some test questions. (Be careful to choose only items that relate to the outcomes for this unit.)

Resources

science.connect1, CD-ROM.

BLM 4-5, *Conduct an Investigation 4-B Worksheet*.

BLM 4-9, *Chapter 4 Chapter Test*.

ICT 4-3, *Defining Acids and Bases*.

BLM 4-4, *Conductivity and pH*.

Unit 4 - Chemical Reactions

Outcomes

- 4.1 Explore the usefulness of chemical reactions.
 - 4.1.1 Define chemical reaction.
 - 4.1.2 Describe ways that chemical reactions are useful.
- 4.2 Investigate the evidence of chemical change.
 - 4.2.1 Test for the presence of common gases produced by chemical reactions. Include: carbon dioxide, hydrogen and oxygen.
 - 4.2.2 Identify evidence for chemical change associated with various reactions.
 - 4.2.3 Examine reactions for evidence of chemical change.
- 4.3 Describe examples of common reactions.
 - 4.3.1 Explain the terms reactants and products.
 - 4.3.2 Describe the reactants and products of common chemical reactions. Include: combustion and neutralization.

Notes for Teaching and Learning

Note that students will use *science.connect2* for this final unit of the course. Instructors should note that only some sections of Chapters 2, 3, and 4 are covered in this unit.

There are many demonstrations that instructors could carry out to show examples of chemical reactions. Refer to the Teacher's Resource for suggestions.

You might start this unit by doing the Starting Point Activity, Flame Tests, on page 41, to capture students' attention and get them interested in learning more about chemical reactions. Refer to the Teacher's Resource for more information on this activity.

In setting up Investigation 2-B, instructors may wish, depending on availability of materials, to alter or replace some of the stations suggested in the text.

Unit 4 - Chemical Reactions

Suggestions for Assessment

Students are required to complete **Core Lab #3**, *Identifying Common Gases*, to investigate tests for the presence of CO₂, H₂ and O₂ produced by chemical reactions. BLM 2-2 should be provided to students to record their observations and may be used as a lab report.

Students are also required to complete **Core Lab #4**, *Investigating Chemical Reactions*, to investigate evidence of chemical change. BLM 2-6 should be provided to students to record their observations and may be used as a lab report. Instructors should refer to the Teacher's Resource for information about the labs and for the answers to the questions.

BLM 2-3 could be used to review the chemical reactions covered in Section 2.1 of the text.

BLM 2-4 could be completed by students to ensure that they understand combustion and neutralization.

BLM 2-5 could be used to reinforce students' understanding of word equations.

BLM 2-7 could be used after the lab for reinforcement of the principles learned in the investigation.

Resources

science.connect2,
Chapter 2, pages 22 - 37.

science.connect2, CD-ROM.

science.connect2
Teacher's Resource, Unit A.

Core Lab #3:
Identifying Common Gases, page 26 .

BLM 2-2, *Identifying Common Gases*.

BLM 2-3, *Match the Terms*.

BLM 2-4, *Combustion and Neutralization*.

BLM 2-5, *Word Equations*.

Core Lab #4:
Investigating Chemical Reactions, pages 32 - 33.

BLM 2-6, *Investigating Chemical Reactions*.

BLM 2-7, *Evidence and Types of Chemical Reactions*.

Unit 4 - Chemical Reactions

Outcomes

4.4 Recognize that energy is absorbed or released by chemical reactions.

4.4.1 Define, operationally, exothermic and endothermic reactions.

4.4.2 Identify reactions as either exothermic and endothermic.

4.5 Investigate and describe acid deposition and its effects on the environment.

Notes for Teaching and Learning

Review with students their observations from Investigation 2-B and classify each reaction as either exothermic or endothermic.

Outcome 4.5 is covered by completion of the assignment outlined in the Study Guide. The assignment asks students to work through the Disc Connect, *Acid Deposition*. Each student is required to pass in the **Summary** and the **Certificate of Completion** printed out from the computer with his/her name on it. The assignment should be marked and the mark obtained should be used as a portion of the final mark for the course. Students **should not** be tested on the material covered in the assignment

Unit 4 - Chemical Reactions

Suggestions for Assessment

BLM 2-12 could be used to assess students' understanding of endothermic and exothermic reactions.

BLM 3-5 could be used for additional practice of using word equations.

A final exam that covers the entire course (excluding the material covered by assignments) should be given and the mark used as at least 50% of the final mark for the course.

BLM 2-14 might be used to supply some questions for Unit 4.

Resources

BLM 2-12, *Endothermic and Exothermic Reactions*.

BLM 3-5, *Word Equations*.

BLM 2-14, *Chapter 2 Chapter Test*.