

Course: Chemistry

Instructor: Mr. M. Sebald

Credits: 1

Instructional Level: Grades 10-12

Textbook: *Introductory Chemistry: A Foundation* (Zumdahl, Fourth edition)

Course Purpose:

God has given us many blessings through his physical creation. As Christians, we are in awe of the precision, order, beauty and mystery of God's creation. In the study of chemistry, students will understand and use the part of God's creation that deals with materials of the universe and the changes these materials undergo. The chemistry course is designed to help students:

- Increase in knowledge, understanding and appreciation for God's awesome creation.
- Develop critical thinking and problem solving skills
- Build interpersonal and communication skills.
- Provide a base for higher-level science classes.

Course outcomes:

The student will be able to:

- Develop an understanding of God's creation by discovering, comparing and organizing the structure, composition, and nature of matter.
- Demonstrate an understanding of the scientific method
- Demonstrate and communicate knowledge of chemistry facts, terminology, concepts and principles.
- Develop the ability to safely handle scientific equipment in order to measure and communicate scientific information.
- Develop the ability to analyze and manipulate data in order to draw and evaluate conclusions in a formal lab report.
- Integrate and apply chemistry knowledge to life situations.

Course Outline:

Unit 1: Chemistry as a science.

- Demonstrate the ability to organize scientific data in both table and graph form by creating computer assisted graphs and tables that have been prepared in a manner accepted by the scientific community.
- Know, understand and demonstrate lab safety rules by passing a safety rules test.
- Demonstrate a knowledge of common metric conversions by solving word problems.
- Demonstrate the ability to form derived units from base units by solving word problems

- Show an understanding of the Christian view of the role of science by rewriting the introductory paragraph of the textbook from a Christian perspective.
- Understand the reasons for and the use of significant figures, scientific notation, percent error and dimensional analysis by solving word problems and applying those concepts in lab situations.

Textbook: pages A6, 15-44

Number of days: 7-10

SO: 1,2,3,6

DO: 1.1-2, 2.1, 3.2, 4.1-3

WSS: A12.5,6,7 B12.4 C12.1,4,5 G12.4

Unit 2: Matter and Energy

- Classify unknowns as elements compounds and mixtures by applying the characteristics of each group.
- Understand the concept of density by solving density problems and calculating the density of unknown objects.
- Distinguish between physical and chemical properties and physical and chemical change by applying these concepts in lab situations
- Understand the concept of calorimetry by solving word problems.
- Apply the law of conservation of mass in lab situations by predicting and confirming the mass of products in a chemical reaction.

Textbook: pages 44-48, 60-77, 93

Number of days: 5-7

SO: 3,4,6

DO:2.1, 3.2, 4.1-2

WSS: D12.1-6, 10, 12

Unit 3: The Atom and Atomic Theory

- Trace the development of the model of the atom and the modern periodic table by identifying key people and events that have contributed to the present day understanding of these.
- Show an understanding of major groups and trends on the periodic table by predicting characteristics of elements and comparing predictions to known properties.
- Show an understanding of the periodic table by arranging hypothetical elements into a periodic table, and explaining and defending their work.
- Show an understanding of energy levels, sublevels and orbitals by making orbital diagrams and electron configurations for selected elements.
- Understand the concept of valence electrons using an element's electron configuration and by location on the periodic table.

Textbook: pages 96-99, 103-118, 309-322

Number of days: 5-7

SO: 3, 4, 6

DO: 2.1, 3.2

WSS: A12.3, 6 C12.6 D12.1,2

Unit 4: Chemical Bonds and Chemical Formulas

- Predict the formulas of compounds using periodic table groups, ion tables and valences.
- Interpret information presented in a chemical formula by solving problems that involve formula mass and percent composition.
- Show an understanding of ionic and covalent bonds by drawing Lewis dot structures of selected compounds.
- Show an understanding of the rules for naming compounds by predicting the names of covalent and ionic compounds.

Textbook: pages 127-147, 332-337, 347-362

Number of days: 8-10

SO: 3, 4, 6

DO: 2.1, 3.2

WSS: D12.4, 5

Unit 5: The Mathematics of Chemical Formulas

- Show an understanding of the mole concept by solving mass/mole/particle/volume problems.
- Show an understanding of the concept of empirical and molecular formulas by solving word problems.
- Predict and confirm the formula of an unknown hydrate in a lab situation.

Textbook: pages 219-247

Number of days: 12-15

SO: 3, 4, 6

DO: 2.1, 3.2, 4.2

WSS: C12.7 D12.6

Unit 6: The Mathematics of Chemical Equations

- Show an understanding of the mole concept by solving mass-mass, mass-volume and mass-particle problems
- Show an understanding of single replacement and double replacement reactions by predicting the products of those reactions.
- Show an understanding of chemical equations by balancing and classifying chemical equations.
- Determine the limiting reactant and mass of products in lab activities and in word problems.

Textbook: pages 203-207, 259-278, 402-405

Number of days: 15-20

SO: 3, 4, 6

DO: 2.1, 3.2

WSS: D12.6, 7,10

Unit 7: The Gas Laws

- Show an understanding of the gas laws formulated by Boyle, Charles, Dalton and Graham by solving various gas law problems and predicting the behavior of gases in real life situations.
- Use the kinetic theory to explain the basis for gas laws.
- Show an understanding of gas laws by applying the proper law in various situations.
- Show an understanding of the absolute temperature scale and the Celsius temperature scale by solving conversion problems.

Textbook: pages 39-44, 372-399, 416-437

Number of days: 10-12

SO: 3, 4, 6

DO: 2.1, 3.2

WSS: B12.5, D12.1

Unit 8: Solutions

- Be able to describe the effects of dissolving substances on the freezing and boiling points of solutions by solving problems and applying concepts to life situations.
- Be able to construct and interpret data in solubility curves and tables by determining the solubility of a compound in a lab situation.
- Show an understanding of molarity and molality by solving word problems.
- Know and discuss the factors that affect solubility and the rate of solution.

Textbook: pages 180-189, 418-460

Number of days: 10-12

SO: 3, 4, 6

DO: 2.1, 3.2, 4.2

WSS: D12. 5-6, 11

Unit 9: Reaction Speed and Chemical Equilibrium

- Be able to derive mass action expressions for various types of equations.
- Explain and apply Le Chatelier's principles in real life situations.
- Understand the collision theory of reactions and explain how this theory relates to the speed of reaction.
- Calculate the concentration of solutions based on given data.

Textbook: pages 512-538

Number of days: 10-13

SO: 3, 4, 6

DO: 2.1, 3.2, 4.2

WSS: D.12.1-6

Unit 10: Acids and Bases

- Be able to determine the strength of acids and bases using indicators and titrations.
- Show an understanding of the concept of “acid rain” by stating the cause of the problem and researching possible solutions.
- Show an understanding of the pH and pOH by solving pH problems.

Textbook: pages 463-465, 486-500, 572

Number of days: 15-20

SO: 3, 4, 6

DO: 2.1, 3.2, 4.2

WSS: D.12.4, 6 G.12.5 H.12.4

Unit 11: Redox Reactions and Electrochemistry

- Show an understanding of redox reactions by balancing various reactions.
- Be able to apply the concept of voltage in half-reactions by constructing electrochemical cells, predicting theoretical voltage and measuring actual voltage.
- Demonstrate knowledge of a dry cell battery by identifying key components.
- Be able to identify the element that is being oxidized and reduced in a reaction.
- Understand the reasons for and ways of protecting a metal from corrosion.

Textbook: pages 180-182, 196-199, 551-574

Number of days: 10-12

SO: 3, 4, 6

DO: 2.1, 3.2, 4.2

WSS: D.12.10-12

Unit 12: Nuclear Chemistry (Optional Unit)

- Be able to complete and balance nuclear equations given the type of radioactive particle emitted.
- Understand the complexities of nuclear waste disposal by drawing or constructing a model of a waste storage facility.
- Be able to calculate the half-life of various isotopes by collecting, organizing and graphing data.
- Understand the beneficial uses and harmful effects of radioactive isotopes.

Textbook: pages 671-674

Number of days: 10-15

SO: 3,4,6

DO: 2.1, 3.2, 4.2

WSS: A.12.1-7 C.12.1-2 H.12.4-7

Instructional Strategies

- 45% Lecture and demonstrations
- 20% Lab Work
- 20% Individual and small group work
- 10% Test, Test Review
- 5% Audio-Visual presentations

Grading and Percentages

- | | |
|------------------------------------|-----------------------------|
| • Tests | 50% of final grade |
| • Lab Reports | 35% of final grade |
| • Daily Work, Worksheets & Quizzes | 15% of final grade |
| • Semester Exam/Final Project | 20% of final semester grade |

Major Lab Projects

- | | |
|------------------|--------------------------------------|
| Quarter 1 | “If it ain’t gooey...it ain’t gummi” |
| Quarter 2 | The Copper Lab |
| Quarter 3 | When is a penny not worth a penny? |
| Quarter 4 | The Yellow Lab (Final Project) |

Appendix
Science Department Outcomes
Chemistry
Mr. M. Sebald

Unit 1

Department Outcomes

Graduates of the WLHS Science Department will be:

1. God-Centered thinkers who

- 1.1 Utilize Scripture as a means of scientific discoveries and technology
- 1.2 Apply God's Word as it relates to science issues

2. Effective communicators who

- 2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

- 3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

- 4.1 Research, evaluate, and use scientific information from a variety of sources
- 4.2 Contribute both independently and cooperatively with their peers
- 4.3 Make decisions using scientific knowledge to assess the effect of scientific discoveries on themselves and society

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

- 1. Regular use of the means of grace and fruits of their faith in Jesus Christ through Christian love, service, and witness.
- 2. Perceptive thinking which integrates experience, research, and reason under God's will as revealed in His Holy Word in critical analysis, problem solving, and decision making.
- 3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.

6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- A.12.5 Show* how the ideas and themes* of science can be used to make real-life decisions about careers, work places, life-styles, and use of resources
- A.12.6 Identify* and, using evidence* learned or discovered, replace inaccurate personal models* and explanations* of science-related events
- A.12.7 Re-examine the evidence* and reasoning that led to conclusions drawn from investigations*, using the science themes*
- B.12.4 Show* how basic research and applied research contribute to new discoveries, inventions, and applications
- C.12.1 When studying science content, ask questions suggested by current social issues, scientific literature, and observations* of phenomena, build hypotheses that might answer some of these questions, design possible investigations*, and describe results that might emerge from such investigations
- C.12.4 During investigations*, choose the best data-collection procedures and materials available, use them competently, and calculate the degree of precision of the resulting data
- C.12.5 Use the explanations* and models* found in the earth and space, life and environmental, and physical sciences to develop likely explanations* for the results of their investigations*
- G.12.4 Show* how a major scientific or technological change has had an impact on work, leisure, or the home

Unit 2

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

4.1 Research, evaluate, and use scientific information from a variety of sources

4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- D.12.1 Describe* atomic structure and the properties of atoms, molecules, and matter during physical and chemical interactions*
- D.12.2 Explain* the forces that hold the atom together and illustrate* how nuclear interactions* change the atom
- D.12.3 Explain* exchanges of energy* in chemical interactions* and exchange of mass and energy in atomic/nuclear reactions
- D.12.4 Explain* how substances, both simple and complex, interact* with one another to produce new substances
- D.12.5 Identify* patterns in chemical and physical properties and use them to predict* likely chemical and physical changes and interactions
- D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions
- D.12.10 Using the science themes*, illustrate* the law of conservation of energy* during chemical and nuclear reactions
- D.12.12 Using the science themes* and knowledge of chemical, physical, atomic, and nuclear interactions*, explain* changes in materials, living things, earth's features, and stars nuclear reactions

Unit 3

Department Outcomes

2. Effective communicators who

- 2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

- 3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

- 3 Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
- 4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
- 6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- A.12.3 Give examples that show* how partial systems*, models*, and explanations* are used to give quick and reasonable solutions that are accurate enough for basic needs
- A.12.6 Identify* and, using evidence* learned or discovered, replace inaccurate personal models* and explanations* of science-related events
- C.12.6 Present the results of investigations* to groups concerned with the issues, explaining* the meaning and implications of the results, and answering questions in terms the audience can understand
- D.12.1 Describe* atomic structure and the properties of atoms, molecules, and matter during physical and chemical interactions*
- D12.2 Explain* the forces that hold the atom together and illustrate* how nuclear interactions* change the atom

Unit 4

Department Outcomes

3. Effective communicators who

- 2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

- 3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

- 3 Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas;

and working cooperatively with others in family, school, church, work, and community settings.

4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.

6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

D.12.4 Explain* how substances, both simple and complex, interact* with one another to produce new substances

D.12.5 Identify* patterns in chemical and physical properties and use them to predict* likely chemical and physical changes and interactions

D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions

Unit 5

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.

4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.

6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

C.12.7 Evaluate* articles and reports in the popular press, in scientific journals, on television, and on the Internet, using criteria related to accuracy, degree of error, sampling, treatment of data, and other standards of experimental design

D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions

Unit 6

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions

D.12.7 Qualitatively and quantitatively analyze* changes in the motion of objects and the forces that act on them and represent analytical data both algebraically and graphically

D.12.10 Using the science themes*, illustrate* the law of conservation of energy* during chemical and nuclear reactions

Unit 7

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.

4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.

6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

B.12.5 Explain* how science is based on assumptions about the natural world and themes* that describe the natural world

D.12.1 Describe* atomic structure and the properties of atoms, molecules, and matter during physical and chemical interactions*

Unit 8

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.

4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- D.12.5 Identify* patterns in chemical and physical properties and use them to predict* likely chemical and physical changes and interactions
- D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions
- D.12.11 Using the science themes*, explain* common occurrences in the physical world

Unit 9

Department Outcomes

2. Effective communicators who

- 2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

- 3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

- 4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- D.12.1 Describe* atomic structure and the properties of atoms, molecules, and matter during physical and chemical interactions*

- D12.2 Explain* the forces that hold the atom together and illustrate* how nuclear interactions* change the atom
- D.12.3 Explain* exchanges of energy* in chemical interactions* and exchange of mass and energy in atomic/nuclear reactions
- D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions

Unit 10

Department Outcomes

2. Effective communicators who

- 2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

- 3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

- 4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

- D.12.4 Explain* how substances, both simple and complex, interact* with one another to produce new substances
- D.12.6 Through investigations*, identify* the types of chemical interactions*, including endothermic, exothermic, oxidation, photosynthesis, and acid/base reactions
- G.12.5 Choose a specific problem in our society, identify* alternative scientific or technological solutions to that problem and argue it merits

H.12.5 Investigate* how current plans or proposals concerning resource management, scientific knowledge, or technological development will have an impact on the environment, ecology, and quality of life in a community or region

Unit 11

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

4.2 Contribute both independently and cooperatively with their peers

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.

4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.

6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Standards

D.12.10 Using the science themes*, illustrate* the law of conservation of energy* during chemical and nuclear reactions

D.12.11 Using the science themes*, explain* common occurrences in the physical world

D.12.12 Using the science themes* and knowledge of chemical, physical, atomic, and nuclear interactions*, explain* changes in materials, living things, earth's features, and stars

Unit 12

Department Outcomes

2. Effective communicators who

2.1 Express an understanding of the major concepts and principles of science and related technology

3. Innovative problem solvers who

3.2 Use scientific knowledge to investigate the natural world, to solve problems, and to make informed opinions

4. Self-directed learners who

4.2 Contribute both independently and cooperatively with their peers

4.3 Make decisions using scientific knowledge to assess the effect of scientific discoveries on themselves and society

School Outcomes

The courses and programs of Wisconsin Lutheran High School will carry out the mission by producing graduates who have demonstrated:

3. Effective communication skills by listening; expressing their thoughts, feelings, faith, and ideas; and working cooperatively with others in family, school, church, work, and community settings.
4. The knowledge, skills, and attitudes necessary to become self-initiating and self-directing life-long learners.
6. The verbal, sociological, scientific, quantitative, and technological literacy necessary for offering God a productive, meaningful life.

State Outcomes

- A.12.1 Apply* the underlying themes* of science to develop defensible visions of the future
- A.12.2 Show* how conflicting assumptions about science themes* lead to different opinions and decisions about evolution*, health, population, longevity, education, and use of resources, and show* how these opinions and decisions have diverse effects on an individual, a community, and a country, both now and in the future
- A.12.3 Give examples that show* how partial systems*, models*, and explanations* are used to give quick and reasonable solutions that are accurate enough for basic needs
- A.12.4 Construct* arguments that show* how conflicting models* and explanations* of events can start with similar evidence*
- A.12.5 Show* how the ideas and themes* of science can be used to make real-life decisions about careers, work places, life-styles, and use of resources
- A.12.6 Identify* and, using evidence* learned or discovered, replace inaccurate personal models* and explanations* of science-related events
- A.12.7 Re-examine the evidence* and reasoning that led to conclusions drawn from investigations*, using the science themes*
- C.12.1 When studying science content, ask questions suggested by current social issues, scientific literature, and observations* of phenomena, build hypotheses that might answer some of

these questions, design possible investigations*, and describe results that might emerge from such investigations

- C.12.2 Identify* issues from an area of science study, write questions that could be investigated*, review previous research on these questions, and design and conduct responsible and safe investigations to help answer the questions
- H.12.4 Advocate a solution or combination of solutions to a problem in science or technology
- H.12.5 Investigate* how current plans or proposals concerning resource management, scientific knowledge, or technological development will have an impact on the environment, ecology, and quality of life in a community or region
- H.12.6 Evaluate* data and sources of information when using scientific information to make decisions
- H.12.7 When making decisions, construct a plan that includes the use of current scientific knowledge and scientific reasoning