

General Science III

Matter and Energy

2009

COURSE DESCRIPTION:

An introduction to the study of the properties and changes in matter and the interaction of matter and energy. Course emphasizes topics such as: classification of matter, chemical shorthand, structure of atoms and compounds, the mole, chemical reactions, solids, liquids, gases, acids/bases, electricity and magnetism. Special sections on nuclear and organic chemistry are included.

OBJECTIVES

After completing the course, students will be able to:

- State the general purpose for the study of chemistry.
- List several fields of study where knowledge of chemistry is important.
- Use scientific units of measurement.
- Describe the structure and components of basic atoms.
- Use the periodic table to locate important chemical information.
- Describe several types of chemical bonds.
- Manipulate common chemical formulas and equations.
- List and describe types of chemical reactions.
- List some physical characteristics of common gases, liquids and solids.
- Describe the behavior of solutions and ions.
- Describe the properties of acids and bases
- Discuss important aspects of nuclear chemistry.
- Discuss important aspects of organic chemistry

CORE CURRICULUM CONTENT STANDARDS:

STANDARD 5.1 (SCIENTIFIC PROCESSES)

All students will develop problem solving, decision-making and inquiry skills, reflected by formulating usable questions and hypotheses, planning experiments, conducting systematic observations, interpreting and analyzing data, drawing conclusions, and communicating results.

STANDARD 5.2 (SCIENCE AND SOCIETY)

All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.

STANDARD 5.3 (MATHEMATICAL APPLICATIONS)

All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

STANDARD 5.4 (NATURE AND PROCESS OF TECHNOLOGY)

All students will understand the interrelationships between science and technology and develop a conceptual understanding of the nature and process of technology.

STANDARD 5.6 (CHEMISTRY)

All students will gain an understanding of the structure and behavior of matter.

STANDARD 5.7 (PHYSICS)

All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.

STANDARD 8.1(Computer and Information Literacy)

All students will use computer applications to gather and organize information and to solve problems.

STANDARD 8.2 (TECHNOLOGY EDUCATION)

All students will develop an understanding and impact of technology, engineering, technological design, and the designed world as they relate to the individual, society and the environment.

CUMULATIVE PROGRESS INDICATORS:

5.1 (Scientific Processes)

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

A. Habits of Mind

1. When making decisions, evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit.
2. Assess the risks and benefits associated with alternative solutions.
3. Engage in collaboration, peer review, and accurate reporting of findings.
4. Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.

B. Inquiry and Problem Solving

1. Select and use appropriate instrumentation to design and conduct investigations.
2. Show that experimental results can lead to new questions and further investigations.

C. Safety

1. Understand, evaluate and practice safe procedures for conducting science investigations.

5.2 (Science and Society)

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

A. Cultural Contributions

1. Recognize the role of the scientific community in responding to changing social and political conditions and how scientific and technological achievement effect historical events.

B. Historical Perspectives

1. Examine the lives and contributions of important scientists who effected major breakthroughs in our understanding of the natural and designed world.
2. Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.
3. Describe the historical origin of important scientific developments such as atomic theory, genetics, plate tectonics, etc., showing how scientific theories develop, are tested, and can be replaced or modified in light of new information and improved investigative techniques.

5.3 (Mathematical Applications)

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

A. Numerical Operations

1. Reinforce indicators from previous grade level.

B. Geometry and Measurement

1. When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data.

C. Patterns and Algebra

1. Apply mathematical models that describe physical phenomena to predict real world events.

D. Data Analysis and Probability

1. Construct and interpret graphs of data to represent inverse and non-linear relationships, and statistical distributions.

5.4 (Nature and Process of Technology)

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

A. Science and Technology

1. Know that scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans, while technology is driven by the need to meet human

needs and solve human problems.

B. Nature of Technology

1. Assess the impacts of introducing a new technology in terms of alternative solutions, costs, tradeoffs, risks, benefits and environmental impact.

C. Technological Design

1. Plan, develop, and implement a proposal to solve an authentic, technological problem.

5.6 (Chemistry)

A. Structure and Properties of Matter

1. Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron.
2. Know that the number of protons in the nucleus defines the element.
3. Know that an atom's electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.
4. Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons.
5. Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure.
6. Know that many biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.
7. Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds.
8. Know that different levels of energy of an atom are associated with different configurations of its electrons.

B. Chemical Reactions

1. Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst.
2. Show that some changes in chemical bonds require a net input or net release of energy.

5.7 (Physics)

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

A. Motion and Forces

1. Apply the mathematical relationship between the mass of an object, the net force exerted on it, and the resulting acceleration.
2. Explain that whenever one object exerts a force on another, an equal and opposite force is exerted on the first object.
3. Recognize gravity as a universal force of attraction between masses and

that the force is proportional to the masses and inversely proportional to the square of the distance between them.

4. Recognize that electrically charged bodies can attract or repel each other with a force that depends upon the size and nature of the charges and the distance between them and know that electric forces play an important role in explaining the structure and properties of matter.
5. Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
6. Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.
7. Demonstrate that moving electric charges can produce magnetic forces and moving magnets can produce electric forces.
8. Recognize that magnetic and electrical forces are different aspects of a single electromagnetic force.

B. Energy Transformations

1. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement.
2. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant.
3. Recognize that whenever mechanical energy is transformed, some heat is dissipated and is therefore unavailable for use.
4. Explain the nature of electromagnetic radiation and compare the components of the electromagnetic spectrum from radio waves to gamma rays.

TECHNOLOGICAL LITERACY

(Computer and Information Literacy)

All students will use computer applications to gather and organize information and to solve problems.

A. Basic Computer Skills and Tools

1. Create a multi-page document with citations using word processing software in conjunction with other tools that demonstrates the ability to format, edit and print.
2. Create documents including a resume and business letter using professional format.
3. Construct a spreadsheet, enter data, use mathematical or logical functions to manipulate and process data, generate charts and graphs, and interpret the results.
4. Given a database, define fields, input data from multiple records, produce a report using sort and query, and interpret the data.

5. Produce a multimedia project using text, graphics, moving images, and sound.
6. Produce and edit page layouts in different formats using desktop publishing and graphics software.
7. Develop a document or file for inclusion into a website or page.
8. Discuss and/or demonstrate the capability of emerging technologies and software in the creation of documents or files.
9. Merge information from one document to another.

C. Applications of Productivity Tools

Social Aspects

1. Describe the potential and implication of contemporary and emerging computer applications for personal, social lifelong learning, and workplace needs.
2. Exhibit legal and ethical behaviors when using information and technology, And discuss consequences of misuse.
3. Make informed choices among technology systems, resources, and services in a variety of contexts.
4. Use appropriate language when communicating with diverse audiences using computer and information literacy.

Information Access and Research

5. Select and use specialized databases for advanced research to solve real world problems.
6. Identify new technologies and other organizational tools to use in personal, home, and/or work environments for information retrieval, entry, and presentation.
7. Evaluate information sources for accuracy, relevance, and appropriateness.
8. Compose, send, and organize e-mail messages with and without attachments.

Problem Solving and Decision Making

9. Create and manipulate information independently and/or collaboratively, to Solve problems and design and develop products.
10. Identify, diagnose, and suggest solutions for non-functioning technology systems.
11. Identify a problem in a content area and formulate a strategy to solve the Problem using brainstorming, flowcharting and appropriate resources.
12. Integrate new information into an existing knowledge base and communicate The results in a project or presentation.

A. Nature and Impact of Technology

1. Use appropriate data to discuss the full costs, benefits and trade-offs, and risks related to the use of technologies.
2. Explain how technological development is affected by competition through a variety of management activities associated with planning, organizing, and controlling the enterprise.
3. Provide various examples of how technological developments have shaped human history.

B. Design Process and Impact Assessment

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.
3. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities.
4. Use a computer assisted design (CAD) system in the development of an appropriate design solution.
5. Diagnose a malfunctioning product and system using appropriate critical thinking methods.
6. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.

8.2 C. Systems in the Designed World

1. Explain the life cycle of a product from initial design to reuse, recycling, remanufacture, or final disposal, and its relationship to people, society, and the environment, including conservation and sustainability principles.
2. Analyze the factors that influence design of products, systems, and environments.
3. Compare and contrast the effectiveness of various products, systems, and environments associated with technological activities in energy, transportation, manufacturing, and information and communication.

SUGGESTED ACTIVITIES:

MAY INCLUDE BUT ARE NOT LIMITED TO:

STANDARD 5.1 (SCIENTIFIC PROCESSES)

- Lab Safety Contract
- All laboratory experiments throughout the year
- Various projects

STANDARD 5.2 (SCIENCE AND SOCIETY)

- News articles throughout the year and write reaction papers on the topics.
- Powerpoint presentation on chemist
- Powerpoint presentation on drug and poison.
- Achieve 3000 ® articles

STANDARD 5.3 (MATHEMATICAL APPLICATIONS)

- Use of various equations throughout the year to solve problems.
- Use of graphs to represent experimental data
- Lab Report Calculations
- Dimensional Analysis
- Metric English Conversions
- Molar Mass Problems
- Balancing Chemical Equations
- Using Oxidation Numbers to write Chemical Formulas

STANDARD 5.4 (NATURE AND PROCESS OF TECHNOLOGY)

- Write reaction paper on a recent technological advance in physics or chemistry.
- Powerpoint presentation on chemist
- Powerpoint presentation on drug and poison.
- Classroom discussion/debate on environmental concerns

STANDARD 5.6 (CHEMISTRY)

- Use of various worksheets to develop an understanding of:
 - Matter
 - The atom
 - Subatomic particles
 - Bonding/Molecules
- Variety of labs demonstrating chemical interactions and other concepts:
 - Density Lab
 - Soap Making
 - Identifying Chemical Reactions
 - Titration (Antacid Lab)
- Demonstrations by Teacher
 - Types of Matter/Mixtures
 - Physical Change vs Chemical Change
 - Endothermic Reaction vs Exothermic Reaction
 - Distillation

STANDARD 5.7 (PHYSICS)

- Use of various worksheets to develop an understanding of :
 - Basic properties of electrical interaction
 - Ohms Law
 - Conservation of Energy
- Labs demonstrating:
 - Static Electricity
 - Law of Conservation of Energy

STANDARD 8.1(COMPUTER AND INFORMATION LITERACY)

- Utilize the computer to write research reports.
- Utilize computers to graph.
- Perform computer based laboratory investigation.
- PowerPoint Presentations by student
- Achieve 3000 ®

STANDARD 8.2 (TECHNOLOGY EDUCATION)

- News article reaction papers on the topics recent technological advance
- Powerpoint presentation on drug and poison.
- Class debate on alternative energy sources

INSTRUCTIONAL STRATEGIES:

- **Direct Instruction**
- **Discussion**
- **PowerPoint Presentations**
- **Lab Work**
- **Demonstrations**
- **Video/United Streaming**
- **Group Work**
- **Smart Board**

EVALUATION/ASSESSMENT OF STUDENTS:

Students will be evaluated/assessed on the following criteria:

- Student Answers to Questions
- Laboratory Reports
- Daily Assignments
- Tests
- Quizzes
- Independent Project

EVALUATION/ASSESSMENT OF CURRICULUM:

This course of study will be evaluated/assessed by instructional staff during the first year of implementation for the purpose of necessary revision at the end of the first year. In addition, this course of study will be reviewed according to the Five-Year Curriculum Review schedule (see attached).

Resources/Bibliography:

Chemistry: *Study of Matter – Prentice Hall*
Chemistry: *Science Spectrum – Holt*
Chemistry: *Chemistry in the Community - AWWA*
Physics: *Principles and Problems – Glencoe*
Physics: *Principles and Problems Lab Manual*

MATTER AND ENERGY

CURRICULUM OUTLINE

	Power Point	Video	Worksheets	Lab/Demo
II) INTRO/REVIEW				
- Define Science	x			
- Scientific Method (quick review)	x			x
- Branches of Science				
- Define Chemistry (<i>History Alchemy</i>)		x		
II) MEASUREMENT				
- Metric System			x	
- Metric conversions (chart)			x	
- English/Metric conversions (DA)			x	
- Density		x	x	x
- Celsius/Far./Kelvin Temp Conv.			x	
- Scientific Notation			x	
III) MATTER				
- Definition/Types	x	x		
- Phases/Phase Changes	x	x		
- Law of Conservation of Matter	x	x		
- Chemical/Physical Properties	x	x		x
- Chemical/Physical Change	x	x		x
- Elements/Compounds/Mixtures (basic)	x	x		x
- Homogeneous vs Heterogeneous				
IV) ENERGY				
- Seven Forms of Energy	x	x		
- Definitions	x	x		
- Law of Conservation of Energy	x	x		x
V) THE ATOM				
- Definition/History	x	x		
- Subatomic Particles	x	x		
- Structure/Energy Levels	x			
- Ions/Oxidation States	x			
- Basic Quantum Mechanics (photon)	x	x	x	
- Atomic Symbols	x	x	x	
VI) PERIODIC TABLE				
- Creation of Mini Table		x	x	x
- Atomic Number vs Mass Number	x			
- Oxidation Numbers	x			
- Period/Family Commonality	x			

- Trends	x			
- Family Names				

	Power Point	Video	Worksheets	Lab/Demo
VII) MOLECULES				
- Chemical Bonding (all 3 types)	x	x		
- Ionic vs Covalent	x		x	
- The Water Molecule	x	x		x
- Elements/Compounds/ <u>Solutions</u> (rev)	x			
- Writing Chemical Formulas		x	x	
- Naming Compounds		x	x	
- Calculation of Molar Mass (GMW)		x	x	
- Avagadro's Number		x		
- Percent Composition		x	x	
VII) CHEMICAL REACTIONS				
- Five Reaction Types	x		x	x
- Balancing Chemical Equations	x	x	x	
- Endothermic vs Exothermic	x			x
VIII) ELECTRICITY AND MAGNETISM				
- Basic properties of electrical interaction		x	x	
- Static electricity				x
- Conductors, insulators, semi conductors			x	
- Ohm's Law			x	
- Series & Parallel circuits			x	x
- Basic properties of magnetic interaction				x
- Electromagnetism				x
XI) ACIDS AND BASES				
- Review Solutions/Polarity of Water	x			
- Dissociation	x			
- Definitions (OH ⁻ vs. H ⁺) <i>Arrhenius Only</i>	x	x		
- Acid indigestion/how Tums ® works	x			x
- Properties of Acids vs. Bases				
- Neutralization	x			x
- pH	x			x
- Common Household Acids and Bases	x			
- Indicators	x			
XII) ORGANIC CHEMISTRY				
- The Wonder of Carbon	x	x		x
- Naming Compounds	x	x		
- Drawing Structures	x	x		
- Distillation/Petroleum Industry	x			x
- Soap	x			x

	Power Point	Video	Worksheets	Lab/Demo
XIII) NUCLEAR CHEMISTRY				
- Basic Nuclear Structure	x			
- Fission/Fusion	x		x	
- Nuclear Decay/Half Life			x	
- Nuclear Reactor/Nuclear Bomb	x			
- Environmental Concerns	x			