Curriculum Guide

Science
Grades 9-12

Office of Education
North American Division
of Seventh-day Adventists

1999

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Introduction

At no time in history has science been more visible and more important to human life and the future of our planet. Newspapers, magazines, and television feature scientific topics prominently every day. Scientific issues are discussed in Congress, in the courts, on Wall Street, at the World Bank, at the United Nations, and at summit meetings as well as in classrooms, laboratories, hospitals, and agricultural centers. We hear about the ozone layer and skin cancer, decertification, genetic engineering, and frost-resistant strawberry plants. . . How memory works, organ transplants, drugs that will prevent heart attacks, in vitro fertilization, AIDS, abortion, conservation, global warming, water pollution, and death with dignity. The destruction of rain forests. Acid rain. Eco-terrorism. Crops that require no insecticides. The extinction of dinosaurs. Chemicals produced by plants that protect them from their enemies. The fate of whales. The language of wolves. The durability of cockroaches. The origin of man. The future of our planet. These are some of today's relevant issues that science programs in Seventh-day Adventist schools must address.

Modern society's need for leaders and technicians in science emphasizes the importance of implementing a science curriculum which enables students to use problem-solving skills and the application of current technology to address these relevant issues. The learning process must incorporate experiential learning, problem based critical thinking activities, cooperative learning methods, the use of appropriate technology as well as direct instruction by the teacher. Instruction should stress relationships among facts, concepts, and principles across the science curriculum and to other curriculum areas. The business world is clamoring for workers who can not only think independently and arrive at unique solutions to old and new problems, but also can work in groups and communicate their ideas effectively through the avenues of reading, writing, listening, speaking and non-verbal language.

It is imperative that the science curriculum includes a common set of concepts to be learned by students in all North American Division of Seventh-day Adventist science courses. Some concepts should be taught using analogies and examples with which students are familiar. Unfamiliar concepts can be learned through experimentation, illustration, and interactive technological resources. All concepts are to be presented with the most up-to-date information available. Many opportunities for the teacher to be innovative in planning learning activities should be provided as class needs dictate. Topics that might be controversial are to be treated in a fair and balanced manner.

The greatest need in science education is still the spirit-filled teacher who is committed to emphasizing Seventh-day Adventist goals, concepts, and values and encouraging the development of scientifically literate students who understand the relationship among science, technology, and responsibility to society.

Philosophy

The Seventh-day Adventist Church recognizes God as the ultimate source of existence and truth. In the beginning, God created in His image a perfect humanity, a perfection later marred by sin. Through Christ and His Spirit, God determined to restore humanity from its lost state. Through the Bible, He has revealed His will to the world, a revelation that supersedes human reason. Through His Church on earth, He seeks the lost for His kingdom.

The basic tenets of the Seventh-day Adventist Church, as well as the inspired writing of Ellen White, are directed toward God's restorative plan for fallen humanity. The Church conducts its own system of education to engender belief in these tenets, within the context of one's personal relationship with Jesus Christ, and to foster a desire to share that relationship with others. Made in God's image, every human being, although fallen, is endowed with attributes akin to those of the Creator. True science is a revelation of the character of God. Although sin has marred the perfection of the original creation, there is more than sufficient evidence in nature that there is a Master Designer of infinite wisdom and power. The student's understanding of fundamental science concepts and the application of inquiry and problem solving skills are essential to the development of a balanced individual who has a sense of awe and wonder of creation.

Adventist education seeks to nurture thinkers rather than mere reflectors of others' thoughts; loving service rather than selfish ambition; maximum development of one's potential; and an appreciation for all that is beautiful, true, and good.

An education of this kind imparts far more than academic knowledge. It is a balanced development of the whole person. Its time dimensions span eternity. In Adventist education, homes, schools, and churches cooperate together with divine agencies in preparing learners for citizenship here on this earth and in the New Earth to come.

Rationale

This curriculum guide has been revised to reflect the essential learning elements that support the unique philosophy of Seventh-day Adventist science education.

The North American Division Curriculum Futures Commission Report, which identified trends and plotted direction for the future, has served as a guide in the production of this revision. Twenty-first century science education curriculum is fated to be different from the past, and this updated guide has attempted to reflect this fact.

This Science Curriculum Guide is written to assist the teacher to incorporate a distinctive Adventist philosophy in the instructional program. It must be recognized that the major impact of this philosophy on the student will come through an enthusiastic, Spirit-led teacher.

The teacher is encouraged to be creative, to react spontaneously in order to capitalize on the inspiration of the moment. Throughout the year, the teacher can thus incorporate the goals, concepts, and values of Seventh-day Adventist science instruction.

General Goals of the Secondary Science Program

The science program will enable the student to accomplish the following:

1. Develop a meaningful relationship with God and with humanity, which is the basis for stewardship of both human and natural resources.

2. Develop those attitudes, values, and aspirations which strengthen belief in God as the Creator and in His special creation.

3. Understand the processes, concepts, classifications, generalizations, and unifying principles which lead to an awareness of God and His creation.

4. Promote a growing interest in and an appreciation for science.

5. Develop fundamental skills in gathering, organizing, interpreting, and communicating scientific information.

6. Develop cooperative learning skills.

7. Master key scientific concepts and processes.

8. Master important science processes and safety skills through laboratory and field investigations.

9. Acknowledge the potential and limitations of science and technology.

10. Recognize the relationships of science, technology, and society.

11. Evaluate current issues involving science and technology.

12. Develop proficiency in critical and creative thinking and problem-solving.

13. Welcome the challenge of conflicting ideas and accept critical analysis.

14. Recognize the necessity of ethics and is application in science.

15. Recognize and appreciate the diverse ethnic contributions to science.

16. Recognize how society influences the development and use of natural resources.

17. Apply scientific concepts and related theories, laws, assumptions, observations, and evidence of solving problems to everyday life.

18. Draw valid conclusions based on data obtained using scientific methods.

19. Recognize and evaluate aptitudes, interests, and abilities in exploring career and vocational opportunities in science.

20. Utilize reference materials to acquire information necessary for understanding a particular topic.

How To Use This Guide

The hallmarks of this science curriculum guide are simplicity, usability, and practicality. It is designed to correlate content with concepts and processes that are universally found through all science subjects. The following steps are recommended for maximizing the use of this guide:

I. Introduction:

Read this section for information regarding issues and societal needs that can be used to make content practical.

II. Philosophy:

Review this material periodically for help in making your science instruction Christ-centered.

III. Rationale:

Become familiar with the purpose for using this curriculum guide before writing a course of study.

IV. Goals:

Read this section often. It's the rudder that will guide science instruction to anticipated ends. These goals should become basic source material in determining what students should know and be able to do as a result of teacher instruction. This section will become a valuable reference tool in writing course outlines. These goals should also be significant determiners of student progress.

V. Subject Area Guide:

The subject area guide should be read carefully prior to developing a course outline. It identifies the course taught and recommends the grade level for the subject. Each subject area section is organized as follows:

A. Course Overview

The course overview describes the content of the course in general terms.

B. Course Goals

In addition to the general goals for teaching science, each subject area section provides a list of course goals that should be consulted when developing a course outline.

C. Concepts and Process Definitions

Each subject area guide contains a list of concept and process definitions that serve as a ready reference to what is intended by or included in each term. These definitions are placed next to the matrix for your convenience. They serve as a quick reminder of what is meant by the terms. A clear understanding of these terms helps to ensure adequate coverage of the essential learnings when the subject is being taught. They may be used to stimulate class discussions and will be helpful in reviewing, reinforcing, clarifying, and providing students with ongoing feedback regarding their progress.

D. Essential Learnings Matrix

A matrix included in each subject area guide correlates topics with esential learnings. Several of the subjects have optional topics which the teacher can cover if time allows. Topics can and should be taught in an order that best suits the specific needs of a class.

Vl. Working Papers:

Accompanying this guide is the document *Focusing on Essential Learnings*. It includes a working paper for each of the 30 science concepts identified in the guide. Each essential learning is explored in greater depth and may serve as a study guide. They may also be used to stimulate class discussion and will be helpful in reviewing, reinforcing, and clarifying subject content. Feel free to make copies of these working papers and distribute as desired. The following components are included in each paper:

1. Introduction

The introduction identifies the essential learnings and describes its significance and value.

2. The Concept

This section provides a more comprehensive description of how the essential learnings works. It utilizes discussion format to better illustrate what is meant by the term.

VII. Sample Test Questions:

A set of sample test questions is included to help illustrate the difference between concept-learning outcomes and the more familiar content-oriented outcomes.

VII. Lab Experiments:

Another document, *Focusing on Science Experiments* is a set of 23 inexpensive, easy but extremely effective lab experiments. We trust you will find this information helpful in supplementing your textual materials.

Definitions

Fact: Valid, consistently observed phenomenon.

Hypothesis: Plausible explanation of an observation.

Law: Concise description of how nature behaves. Sometimes this description takes the form of a relationship or equation between quantities.

Model: Analogy or mental image of phenomenon in terms of something familiar, ranging from mathematical formulas to verbal description, physical objects.

Observation: Object or event perceived.

Theory: Explanation of phenomena based on observation, experimentation and especially one which has been validated as a general principle useful to explain and predict natural phenomenon.

Truth: That which is supported by facts consistent with beliefs.

Strands

Relationships	Inquiry	God and His Word	Concepts

Essential Learnings

Gradient	Model	Designer/Sustainer	Conservation
Cycle	Perception	Order	Energy-Matter
Change	Quantification	Organism	Entropy
Cause-Effect	Replication	Origins	Fields
Equilibrium	Scale		Force
Interaction	System		Fundamental Entity
Population	Theory		Invariance
Probability	Validation		Space-Time
Symmetry			
Significance			

Scope and Sequence

Essential Learnings	Biology	Chemistry	Earth Science	Physical Science	Physics
Cause-Effect	√	√	√	√	√
Change	√	√	√	√	√
Conservation	√	√	√	√	√
Cycle	√	√	√	√	√
Energy-Matter	√	√	√	√	√
Entropy		√	√		√
Equilibrium	√	√	√	√	√
Fields		√	√	√	√
Force		√	√	√	√
Fundamental Entity	√	√	√	√	√
God-Designer/Sustainer	√	√	√	√	√
Gradient	√	√	√	√	√
Interaction	√	√	√	√	√
Invariance		√			√
Model	√	√	√	√	√
Order	√	√	√	√	√
Organism	√				
Origins	√		√		
Perception		√	√	√	
Population	√				
Probability	√	√	√		
Quantification	√	√	√	√	√
Replication	√	√		√	√
Scale		√	√	√	√
Significance	√	√	√	√	√
Space-Time					√
Symmetry	√		√		
System	√	√	√		√
Theory	√	√	√	√	√
Validation	√	√	√	√	√

Biology

Biology

	Carnegie Unit	Semester Periods
Units of Credit	1	10

Recommended Grade Level: 10

This course is designed to fulfill the requirements for high school gradation.

COURSE OVERVIEW

Biology is the study of life and its Creator. This laboratory course is based on the interaction of living and nonliving things. Emphasis is placed on scientific method, controlled experiments, logic, and theory. Scientific laws, theories, principals, and concepts are stressed during the course.

COURSE GOALS

The biology course will promote the following:

— recognition of the role of God as Creator, Master Designer, and Sustainer of all life.

— development of an appreciation for both the exquisite beauty and complexity created for us by a generous God.

— respect for the earth's resources and recognition of the individual's role in the wise and ethical stewardship of resources.

— understanding of classification systems of organisms.

— understanding of the interrelationship between structure and function in cells, tissues, organs, and systems.

— recognition of the molecular basis of structure and function.

— understanding of the interaction of living organisms and the environment.

— understanding of the principles of heredity and genetics.

— recognition of the factors that influence population growth, stability and decline.

— application of the mathematics necessary for understanding the quantitative aspects of biology.

Science Essential Learnings

1.	**Cause-Effect**	Correlatives enabling predictions to be made
2.	**Change**	Becoming different
3.	**Conservation**	The sum of a quantity remains constant after an interaction; resource management
4.	**Cycle**	A pattern in which events or conditions are repeated at regular intervals
5.	**Energy-Matter**	Energy and matter are mutually convertible equivalents
6.	**Entropy**	A measure of the degree of disorder in a substance or a system
7.	**Equilibrium**	A state of balance or equality between opposing forces
8.	**Field**	Special influence on some physical quantity
9.	**Force**	A push or pull
10.	**Fundamental Entities**	Units of structure and function useful in explaining phenomena
11.	**God-Designer/Sustainer**	Entity who designed and sustains the universe
12.	**Gradient**	The change in value of a quantity per unit distance in a specified direction
13.	**Interaction**	Two or more things influencing each other
14.	**Invariance**	A characteristic which stays constant even though other characteristics may change
15.	**Model**	Analogy or mental image of a phenomenon
16.	**Order**	Viewing nature as being systematic
17.	**Organism**	An individual living or once living thing
18.	**Origins**	Beginnings of life and order in the universe
19.	**Perception**	Sensory discernment of the real world
20.	**Population**	A set of fundamental entities having common characteristics
21.	**Probability**	Appearing reasonable on the basis of evidence or logic—not certain nor proven
22.	**Quantification**	Assignment of numbers or measurements to phenomena or observation
23.	**Replication**	Repetition under controlled condition to get the same result
24.	**Scale**	A set of relative values for measuring
25.	**Significance**	Differences too great to be reasonably attributable to chance
26.	**Space-Time**	Interrelations between distance and duration
27.	**Symmetry**	Similarity of form on either side of a division
28.	**System**	An arrangement of interrelated things to make a whole
29.	**Theory**	Explanation of phenomena
30.	**Validation**	Obtaining similar results by two or more different methods

Science Processes

1.	**Classifying**	Systematically imposing order on data
2.	**Communicating**	Exchanging information
3.	**Controlling Variables**	Identifying and managing factors that may influence an experiment
4.	**Defining Operationally**	Describing terms in the context of a system
5.	**Designing Experiments**	Planning data-gathering operations to test hypotheses or answer questions
6.	**Formulating Models**	Devising representations to describe the real things
7.	**Hypothesizing**	Formulating an explanation as the basis for further investigation
8.	**Inferring**	Recognizing an implied relationship between ideas
9.	**Interpreting Data**	Finding patterns of meaning in observations
10.	**Measuring**	Using instruments to determine value
11.	**Observing**	Using senses to obtain information
12.	**Experimenting**	Testing of a hypothesis
13.	**Predicting**	Anticipating outcomes from information
14.	**Questioning**	Challenging data, hypothesis, and process
15.	**Solving Problems**	Identifying needed information and strategies, and synthesizing components into a solution
16.	**Stating a Conclusion**	Expressing an answer to a question
17.	**Using Numbers/Symbols**	Performing mathematical operations on data

Biology Essential Learnings Matrix

(Required)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Fundamental Entities	God/Designer/Sustaine	Gradient	Interaction	Model	Order	Organism	Origins	Population	Probability	Quantification	Replication	Significance	Symmetry	System	Theory	Validation
Ecology																							
Ecosystems			●	●	●			●		●		●	●		●				●		●		
Community	●	●						●		●	●		●		●						●		
Population		●		●				●		●			●		●			●			●		
Human Interaction	●	●	●					●		●						●							
Cells																							
Chemical Bases		●			●	●	●				●											●	
Structure & Function	●		●				●	●		●	●	●	●						●		●	●	●
Energy & Transport	●	●	●		●	●			●	●													
Respiration & Photosynthesis	●			●	●			●	●	●	●		●						●			●	
Nucleic Acids			●				●				●		●										
Cell Reproduction	●	●		●							●	●	●					●	●				
Replication & Protein Synthesis	●	●	●	●						●	●	●	●					●	●				
Genetics																							
Mendelian Genetics		●	●					●		●	●	●	●			●		●				●	●
Genes & Chromosomes		●	●				●	●					●	●				●		●			
Patterns of Inheritance	●	●	●					●		●	●		●		●	●		●					●
Gene Expression	●	●	●				●	●		●	●		●						●				●
Applied Genetics	●	●						●		●			●		●	●		●					●
Genetic Engineering	●	●						●		●			●					●					●

Biology Essential Learnings Matrix

(Required—Cont'd)

	Cause- Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Model	Order	Organism	Origins	Population	Probability	Quantification	Replication	Significance	Symmetry	System	Theory	Validation
Origins																							
Beginnings		●			●		●	●			●			●		●							●
Fossils & Floods	●	●						●	●		●		●										●
Dynamic Earth		●								●	●											●	
Organisms		●											●	●	●								
Personal Philosophy								●											●				●
Monerans, Protists, & Fungi																							
Viruses & Monerans	●							●		●		●	●		●			●					
Protists	●							●		●		●	●		●								
Fungi				●				●		●		●	●					●					
Plantae																							
Nonvascular Plants				●				●		●		●	●		●								
Vascular Plants				●				●		●		●	●		●						●		
Structure & Function			●					●					●								●		
Growth & Responses	●	●		●				●					●										
Animalia																							
Lower Invertebrates				●				●		●		●	●							●	●		
Arthropods				●				●		●		●	●		●					●	●		
Vertebrates			●	●				●		●		●	●		●					●	●		
Human Biology		●	●					●		●		●	●		●					●	●		
Drug Abuse - Optional	●	●								●													●

Chemistry

Chemistry

	Carnegie Unit	Semester Unit
Units of Credit:	1	10

Recommended Grade Level: 11, 12

This course may be used to satisfy requirements for high school graduation.

COURSE OVERVIEW

Chemistry is the study of the composition and changes of matter. Chemistry is a descriptive and quantitative science based on controlled experiments, logic and theory. Emphasis is placed on measurement, problem solving, and the processes of physical and chemical change. Models are used to explain observable phenomena and are verified by experimentation and observation. Scientific laws, theories, principles, and concepts are taught from a perspective that promotes an appreciation for the wisdom and creative power of God.

COURSE GOALS

The chemistry course will help the student to achieve the following:

— understand the basic laws and theories that apply to chemistry.

— use conceptual models in the study of chemistry.

— understand the structure and/or characteristics of matter and energy.

— use mathematics as a tool to interpret experiments and understand chemistry.

— observe phenomena and record data; then organize, interpret, and draw valid conclusions based on that data.

— safely use laboratory instruments, equipment, and materials.

— use reference materials to secure information necessary to understand a particular aspect of chemistry.

— recognize the importance of continued scientific research to help solve chemistry-related problems in society.

— internalize an ethical approach to use and disposal of chemicals

— recognize career and vocational opportunities in chemistry-related fields.

— discern the wisdom and power of God, who has designed the laws that govern the phenomena that we observe in chemistry.

Science Essential Learnings

1.	**Cause-Effect**	Correlatives enabling predictions to be made
2.	**Change**	Becoming different
3.	**Conservation**	The sum of a quantity remains constant after an interaction; resource management
4.	**Cycle**	A pattern in which events or conditions are repeated at regular intervals
5.	**Energy-Matter**	Energy and matter are mutually convertible equivalents
6.	**Entropy**	A measure of the degree of disorder in a substance or a system
7.	**Equilibrium**	A state of balance or equality between opposing forces
8.	**Field**	Special influence on some physical quantity
9.	**Force**	A push or pull
10.	**Fundamental Entities**	Units of structure and function useful in explaining phenomena
11.	**God-Designer/Sustainer**	Entity who designed and sustains the universe
12.	**Gradient**	The change in value of a quantity per unit distance in a specified direction
13.	**Interaction**	Two or more things influencing each other
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19.	**Perception**	Sensory discernment of the real world
20.	**Population**	A set of fundamental entities having common characteristics
21.	**Probability**	Appearing reasonable on the basis of evidence or logic—not certain nor proven
22.	**Quantification**	Assignment of numbers or measurements to phenomena or observation
23.	**Replication**	Repetition under controlled condition to get the same result
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Science Processes

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8.	**Inferring**	Recognizing an implied relationship between ideas
9.	**Interpreting Data**	Finding patterns of meaning in observations
10.	**Measuring**	Using instruments to determine value
11.	**Observing**	Using senses to obtain information
12.	**Experimenting**	Testing of a hypothesis
13.	**Predicting**	Anticipating outcomes from information
14.	**Questioning**	Challenging data, hypothesis, and process
15.	**Solving Problems**	Identifying needed information and strategies, and synthesizing components into a solution
16.	**Stating a Conclusion**	Expressing an answer to a question
17.	**Using Numbers/Symbols**	Performing mathematical operations on data

Chemistry Essential Learnings Matrix

(Required)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Entropy	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Perceptions	Probability	Quantification	Replication	Scale	Significance	Space-Time	Symmetry	System	Theory	Validation
Measurements																												
Metric System		●								●										●		●				●		
Factor-Label Method		●														●				●								
Scientific Notation																				●								
Figures																●				●			●					
Percent Error	●																			●	●							●
Energy																												
Concept of Energy				●	●	●	●			●	●	●				●	●						●	●		●	●	
Forms of Energy		●			●					●			●		●			●									●	
Energy Measurement		●			●				●	●				●						●		●						●
Energy Conservation	●	●	●		●								●		●												●	
Matter																												
Characteristics			●	●	●					●	●					●	●							●	●			
Mass/Volume./Density	●	●			●			●		●		●		●						●		●	●					●
Chemical/Physical/Changes	●	●	●	●	●	●	●				●		●	●	●	●			●	●						●	●	●
Chemistry Structure																												
Symbols										●				●		●										●		
Elements/Compounds										●	●		●		●	●				●						●		
Atoms/Ions/Molecules									●	●	●		●		●	●				●						●		
Bonding	●	●	●		●				●	●	●	●	●	●	●	●				●							●	
Nomenclature										●					●	●				●			●			●		●

Chemistry Essential Learnings Matrix

(Required—Cont'd)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Entropy	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Perceptions	Probability	Quantification	Replication	Scale	Significance	Space-Time	Symmetry	System	Theory	Validation
Periodicity																												
Periodic Law				●							●					●							●				●	●
Periodic Table				●						●					●	●						●	●			●		●
Met./Nonmet./Mtlds										●						●										●		
State of Matter																												
Gases		●		●	●		●		●	●	●	●	●		●	●		●									●	
Liquids		●		●	●		●		●	●	●	●	●		●	●		●									●	
Solid		●		●	●		●		●	●	●		●		●	●		●									●	
Plasma		●			●				●	●	●				●												●	
Stoichiometry																												
Moles										●						●				●			●					
Molar Relationships		●	●				●						●			●				●								
Chemical Reactions	●	●	●		●	●	●			●			●		●	●		●	●	●	●		●				●	
Percentage Composition			●							●				●		●				●								●
Solutions																												
Types of Solutions												●		●				●								●		●

Solubility	●	●				●	●		●	●		●	●		●					●		●						
Concentration		●				●	●			●		●								●		●	●				●
Acids/Bases/Salts	●	●					●			●	●	●	●	●	●	●				●		●				●	●

Chemistry Essential Learnings Matrix

(Optional)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Entropy	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Perceptions	Probability	Quantification	Replication	Scale	Significance	Space-Time	Symmetry	System	Theory	Validation
Chemical Kinetics																												
Nature of Reaction		●											●			●					●							
Catalysts	●	●	●							●			●		●												●	
Enthalpy	●	●			●					●										●		●	●				●	
Entropy	●	●			●					●										●		●	●				●	
Chemical Equilibrium																												
Characteristics	●	●		●							●		●		●	●												
Factors Affecting		●			●	●																						
Electrochemistry																												
Electrochem. Cells					●					●					●	●										●		
Electrochem.React	●	●			●			●	●	●			●		●	●				●			●			●	●	
*Organic Chemis*try																												
Classification										●						●									●			●
Characteristics											●																	
Reactions	●	●			●								●		●					●								

Polymers/Biochemicals					●					●			●		●	●				●			●					
Nuclear Chemistry																											
Radioactivity		●			●	●				●				●	●				●		●		●	●			●	
Fission		●			●								●		●									●	●				
Fusion		●			●								●		●									●	●				

Earth Science

Earth Science

Recommended Grade Level: 9-12

This course may be used to satisfy requirements for high school graduation.

COURSE OVERVIEW

Earth science is the study of the earth, its characteristics, its meteorological phenomena, astronomy, and the correlation of these topics to Scripture. As students study geomorphic features and major geologic processes of the past, present, and future, they should gain a greater appreciation of God as the Creator and Sustainer of the universe. Included as major topics are geology, astronomy, meteorology, and oceanography. Some topics selected are not developed at other levels of curriculum and are best taught in the subject of Earth Science. Topics will be taught from a content and concept basis with an emphasis on scientific processes and correlation to the scriptural accounts of Creation and the Flood.

COURSE GOALS

The earth science course will help students to do the following:

— understand the basic laws, principles, and theories of earth science.

— use and understand conceptual models to explain earth phenomena.

— identify geomorphic features on a given object, i.e., planet, sun, comets.

— understand the major geologic processes and how they shape the objects in the solar system.

— understand the implications of the theories of geologic time and evolutionary change.

— contract geologic time scales with the time scale of Creation as recorded in Scripture.

— recognize geomorphic features and explain the geologic processes of the earth.

— understand the influences of the geology of an area on the quality of living in that area.

— be aware of environmental changes in relation to geomorphic changes.

— value the understanding of earth science concepts and processes.

— develop hypotheses that explain the observable features of the earth.

— understand the implications of Noah’s flood and the massive, fossil-bearing, sedimentary deposits in the earth’s crust.

— be aware of career opportunities in the field of earth science and the requirements of those vocations.

Science Essential Learnings

1.	**Cause-Effect**	Correlatives enabling predictions to be made
2.	**Change**	Becoming different
3.	**Conservation**	The sum of a quantity remains constant after an interaction; resource management
4.	**Cycle**	A pattern in which events or conditions are repeated at regular intervals
5.	**Energy-Matter**	Energy and matter are mutually convertible equivalents
6.	**Entropy**	A measure of the degree of disorder in a substance or a system
7.	**Equilibrium**	A state of balance or equality between opposing forces
8.	**Field**	Special influence on some physical quantity
9.	**Force**	A push or pull
10.	**Fundamental Entities**	Units of structure and function useful in explaining phenomena
11.	**God-Designer/Sustainer**	Entity who designed and sustains the universe
12.	**Gradient**	The change in value of a quantity per unit distance in a specified direction
13.	**Interaction**	Two or more things influencing each other
14.	**Invariance**	A characteristic which stays constant even though other characteristics may change
15.	**Model**	Analogy or mental image of a phenomenon
16.	**Order**	Viewing nature as being systematic
17.	**Organism**	An individual living or once living thing
18.	**Origins**	Beginnings of life and order in the universe
19.	**Perception**	Sensory discernment of the real world
20.	**Population**	A set of fundamental entities having common characteristics
21.	**Probability**	Appearing reasonable on the basis of evidence or logic—not certain nor proven
22.	**Quantification**	Assignment of numbers or measurements to phenomena or observation
23.	**Replication**	Repetition under controlled condition to get the same result
24.	**Scale**	A set of relative values for measuring
25.	**Significance**	Differences too great to be reasonably attributable to chance
26.	**Space-Time**	Interrelations between distance and duration
27.	**Symmetry**	Similarity of form on either side of a division
28.	**System**	An arrangement of interrelated things to make a whole
29.	**Theory**	Explanation of phenomena
30.	**Validation**	Obtaining similar results by two or more different methods

Science Processes

1.	**Classifying**	Systematically imposing order on data
2.	**Communicating**	Exchanging information
3.	**Controlling Variables**	Identifying and managing factors that may influence an experiment
4.	**Defining Operationally**	Describing terms in the context of a system
5.	**Designing Experiments**	Planning data-gathering operations to test hypotheses or answer questions
6.	**Formulating Models**	Devising representations to describe the real things
7.	**Hypothesizing**	Formulating an explanation as the basis for further investigation
8.	**Inferring**	Recognizing an implied relationship between ideas
9.	**Interpreting Data**	Finding patterns of meaning in observations
10.	**Measuring**	Using instruments to determine value
11.	**Observing**	Using senses to obtain information
12.	**Experimenting**	Testing of a hypothesis
13.	**Predicting**	Anticipating outcomes from information
14.	**Questioning**	Challenging data, hypothesis, and process
15.	**Solving Problems**	Identifying needed information and strategies, and synthesizing components into a solution
16.	**Stating a Conclusion**	Expressing an answer to a question
17.	**Using Numbers/Symbols**	Performing mathematical operations on data

Earth Science Essential Learnings Matrix

(Required)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Entropy	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Model	Order	Origins	Perception	Probability	Quantification	Scale	Significance	Symmetry	System	Theory	Validation
Structure and Composition of Earth																									
Nature of Matter	●	●	●		●	●	●	●	●	●	●		●	●	●		●	●						●	●
Minerals	●	●		●			●		●	●			●		●				●	●		●	●	●	●
Rocks	●			●			●		●				●	●	●				●	●		●	●	●	●
Shape, Dimensions, Heat	●								●			●	●												
Earth's Resources	●	●	●	●	●		●		●		●	●	●	●			●		●		●			●	●
Map														●					●	●	●				
Changes in Earth Crust																									
Plate Tectonics	●	●			●	●		●	●		●		●	●							●			●	●
Earthquakes & Volcanos	●	●			●	●		●	●	●			●	●				●			●			●	●
Weathering	●	●	●	●	●				●				●	●					●		●			●	●
Erosion & Deposition	●	●		●	●				●				●	●					●		●			●	●
Earth's Water																									
Fresh			●	●					●		●	●		●	●	●					●			●	●
Ocean				●					●		●	●		●	●	●		●			●			●	●
Atmospheric Force																									
Weather	●	●		●							●		●	●									●	●	●
Atmosphere	●	●		●	●			●	●		●	●		●									●		
Water in Atmosphere	●	●		●			●				●	●	●	●				●			●		●		
Climate	●	●		●			●				●		●	●							●		●	●	●

Earth Science Essential Learnings Matrix

(Required—Cont'd)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Entropy	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Model	Order	Origins	Perception	Probability	Quantification	Scale	Significance	Symmetry	System	Theory	Validation
Exploring the Universe																									
Stars & Galaxies	●	●			●	●		●	●		●		●	●	●	●	●	●	●	●	●		●	●	●
Sun	●	●		●	●	●		●	●		●		●	●	●	●	●		●	●	●		●	●	●
Solar System	●	●		●	●	●	●	●	●		●		●	●	●	●	●		●	●	●		●	●	●
Moons & Rings	●	●		●	●			●	●		●		●	●	●	●	●		●	●	●		●	●	●
History of the Earth																									
Rock Record	●	●			●				●		●			●		●	●				●			●	●
History	●	●			●				●		●			●	●	●	●				●			●	●
Creation vs. Evolution	●	●			●				●	●	●		●	●	●	●	●	●			●			●	●
Scientific Process	●	●											●	●	●						●			●	●

Physical Science

Physical Science

	Carnegie Units	Semester Periods
Units of Credit:	1	10

Recommended Grade Level: 9-12

COURSE OVERVIEW

Physical science is a laboratory science based upon the analysis of data. The realm of physical science includes physics, chemistry, and the interaction of these upon the environment. The topic/concept matrix is a listing of recommended concepts for each topic but is not necessarily comprehensive. The teacher is encouraged to implement as many of the concepts per topic as is feasible.

COURSE GOALS

The physical science course will assist the student to do the following:

— develop those attitudes, values, and aspirations that strengthen belief in God as Designer, Creator, and Sustainer.

— discover the principles governing chemical and physical phenomena.

— discern the wisdom and power of God, who has designed the laws that govern the physical and chemical world.

— understand and apply the concepts identified in the matrix to explain, communicate, and predict physical and chemical phenomena.

— use conceptual models in the study of physical science.

— observe, collect, and interpret data and make inferences from that data.

— safely use laboratory instruments, equipment, and materials.

— recognize career and vocational opportunities in physical science.

Science Essential Learnings

1.	**Cause-Effect**	Correlatives enabling predictions to be made
2.	**Change**	Becoming different
3.	**Conservation**	The sum of a quantity remains constant after an interaction; resource management
4.	**Cycle**	A pattern in which events or conditions are repeated at regular intervals
5.	**Energy-Matter**	Energy and matter are mutually convertible equivalents
6.	**Entropy**	A measure of the degree of disorder in a substance or a system
7.	**Equilibrium**	A state of balance or equality between opposing forces
8.	**Field**	Special influence on some physical quantity
9.	**Force**	A push or pull
10.	**Fundamental Entities**	Units of structure and function useful in explaining phenomena
11.	**God-Designer/Sustainer**	Entity who designed and sustains the universe
12.	**Gradient**	The change in value of a quantity per unit distance in a specified direction
13.	**Interaction**	Two or more things influencing each other
14.	**Invariance**	A characteristic which stays constant even though other characteristics may change
15.	**Model**	Analogy or mental image of a phenomenon
16.	**Order**	Viewing nature as being systematic
17.	**Organism**	An individual living or once living thing
18.	**Origins**	Beginnings of life and order in the universe
19.	**Perception**	Sensory discernment of the real world
20.	**Population**	A set of fundamental entities having common characteristics
21.	**Probability**	Appearing reasonable on the basis of evidence or logic—not certain nor proven
22.	**Quantification**	Assignment of numbers or measurements to phenomena or observation
23.	**Replication**	Repetition under controlled condition to get the same result
24.	**Scale**	A set of relative values for measuring
25.	**Significance**	Differences too great to be reasonably attributable to chance
26.	**Space-Time**	Interrelations between distance and duration
27.	**Symmetry**	Similarity of form on either side of a division
28.	**System**	An arrangement of interrelated things to make a whole
29.	**Theory**	Explanation of phenomena
30.	**Validation**	Obtaining similar results by two or more different methods

Science Processes

1.	**Classifying**	Systematically imposing order on data
2.	**Communicating**	Exchanging information
3.	**Controlling Variables**	Identifying and managing factors that may influence an experiment
4.	**Defining Operationally**	Describing terms in the context of a system
5.	**Designing Experiments**	Planning data-gathering operations to test hypotheses or answer questions
6.	**Formulating Models**	Devising representations to describe the real things
7.	**Hypothesizing**	Formulating an explanation as the basis for further investigation
8.	**Inferring**	Recognizing an implied relationship between ideas
9.	**Interpreting Data**	Finding patterns of meaning in observations
10.	**Measuring**	Using instruments to determine value
11.	**Observing**	Using senses to obtain information
12.	**Experimenting**	Testing of a hypothesis
13.	**Predicting**	Anticipating outcomes from information
14.	**Questioning**	Challenging data, hypothesis, and process
15.	**Solving Problems**	Identifying needed information and strategies, and synthesizing components into a solution
16.	**Stating a Conclusion**	Expressing an answer to a question
17.	**Using Numbers/Symbols**	Performing mathematical operations on data

Physical Science Essential Learnings Matrix

(Required)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Interaction	Invariance	Model	Order	perception	Quantification	Scale	Significance	Theory	Validation
Waves, Sound, & Light																				
Types		●							●	●			●	●		●			●	●
Characteristics				●			●		●	●	●	●				●				
Production	●	●	●	●									●	●					●	●
Behavior	●						●				●		●	●					●	●
Intensity		●			●		●	●		●						●	●			
Electro Magnetic Waves		●	●	●			●		●	●	●		●	●	●		●	●	●	●
Reflection	●	●									●									
Refraction	●	●									●									
Diffraction	●	●									●									
Polarization	●	●									●									
Color	●	●			●					●	●				●		●	●		
Images	●									●					●			●		
Optical Instruments															●	●				
Matter																				
Properties	●				●				●	●		●		●				●		
States	●	●	●			●				●	●		●					●		
Gas Laws	●	●			●			●		●	●	●	●			●	●	●	●	●
Elements	●				●				●	●			●	●				●		
Compounds	●	●	●			●					●	●	●			●				
Mixtures	●	●	●								●	●	●			●				
Atoms	●	●	●		●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Nuclei	●	●	●		●	●			●	●	●	●	●	●		●	●	●	●	●

Physical Science Essential Learnings Matrix

(Required—Cont'd)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Interaction	Invariance	Model	Order	perception	Quantification	Scale	Significance	Theory	Validation
Chemistry																				
Bonding	●	●					●	●		●	●	●	●	●				●	●	●
Conservation of Mass			●		●					●		●		●		●		●	●	●
Water								●		●				●						
Solutions	●	●	●			●					●					●				
Carbon Compounds										●	●		●	●		●		●		
Food Chemistry	●	●								●	●					●		●		
Reaction Types	●	●								●	●									
Reaction Rates	●	●	●			●		●		●	●	●	●	●		●		●		
Acids, Bases	●	●				●				●	●					●		●		
Salts										●	●					●		●		
Energy & Environment																				
Combustion	●	●			●						●							●	●	●
Air Quality	●	●								●	●				●	●	●	●		
Water Quality	●	●								●	●				●	●	●	●		
Corrosion	●	●									●		●			●		●		
Energy Conservation			●		●					●			●	●		●		●	●	●
Fuels			●		●											●		●		
Alternative Energy					●						●				●	●		●		
Anti-Pollution										●	●				●	●		●		

Physics

Physics

Recommended Grade Level: 11, 12

This course may be used to satisfy graduation requirements.

COURSE OVERVIEW

Physics is a laboratory science based upon the analysis of data. The realm of physics includes interactions of energy and matter in the physical universe.

COURSE GOALS

The physics course will help the student to do the following:

— develop those attitudes, values, and aspirations that strengthen belief in God as Creator.

— understand the physical properties, laws, and unifying principles of physics and how they make us aware of the Creator.

— apply the concepts identified in the matrix to explain, communicate, and predict physical phenomena.

— be able to observe, collect, and interpret data and make inferences from that data, and value data collection as a means of verifying scientific theories and models.

— safely use equipment such as meters, balances, thermometers, and computers.

— increase interest and knowledge of physics by learning from a variety of sources.

— understand that physics, technology, and society influence one another.

— recognize the tentative nature and limitations of science.

— recognize the necessity of ethics and its application to physics.

— appreciate the generosity of God in designing the universe not only for function, but also for beauty and order.

— increase appreciation for scientific explanations in vocations and avocations.

Science Essential Learnings

1.	**Cause-Effect**	Correlatives enabling predictions to be made
2.	**Change**	Becoming different
3.	**Conservation**	The sum of a quantity remains constant after an interaction; resource management
4.	**Cycle**	A pattern in which events or conditions are repeated at regular intervals
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7.	**Equilibrium**	A state of balance or equality between opposing forces
8.	**Field**	Special influence on some physical quantity
9.	**Force**	A push or pull
10.	**Fundamental Entities**	Units of structure and function useful in explaining phenomena
11.	**God-Designer/Sustainer**	Entity who designed and sustains the universe
12.	**Gradient**	The change in value of a quantity per unit distance in a specified direction
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22.	**Quantification**	Assignment of numbers or measurements to phenomena or observation
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Science Processes

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9.	**Interpreting Data**	Finding patterns of meaning in observations
10.	**Measuring**	Using instruments to determine value
11.	**Observing**	Using senses to obtain information
12.	**Experimenting**	Testing of a hypothesis
13.	**Predicting**	Anticipating outcomes from information
14.	**Questioning**	Challenging data, hypothesis, and process
15.	**Solving Problems**	Identifying needed information and strategies, and synthesizing components into a solution
16.	**Stating a Conclusion**	Expressing an answer to a question
17.	**Using Numbers/Symbols**	Performing mathematical operations on data

Physics Essential Learnings Matrix

(Required)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Probability	Quantification	Replication	Scale	Space-Time	System	Theory	Validation
Physical Quantities																								
Fundamental					●				●	●			●		●			●		●	●	●		
Derived					●			●	●				●		●			●		●	●	●		
Scalars & Vectors																								
Characteristics																		●		●	●	●		
Representation														●				●		●	●			
Math Operations															●			●		●	●	●		
Statics																								
Force	●				●		●	●				●						●			●			
Transnational Equilibrium						●							●						●		●	●		●
Torque	●				●			●				●						●			●			
Rotational Equilibrium						●							●						●		●	●		●
Kinematics																								
Displacement		●							●									●			●			
Velocity		●							●									●			●			
Acceleration		●							●									●			●			
Dynamics																								
Newton's Laws of Motion	●	●						●	●	●		●		●	●	●		●	●		●		●	●
Gravity	●						●	●		●	●	●	●	●	●			●			●		●	
Momentum	●	●	●									●			●			●	●		●	●		●
Projectile Motion	●	●						●				●					.	●			●			
Simple Harmonic Motion	●	●		●				●				●						●			●			
Circular Motion	●	●		●				●				●						●			●			
Relativity	●	●					●			●		●		●	●	●		●	●		●	●	●	●

Physics Essential Learnings Matrix

(Optional)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Probability	Quantification	Replication	Scale	Space-Time	System	Theory	Validation
Mechanical Energy																								
Work	●							●				●						●			●			
Power								●				●						●			●			
Energy					●			●				●						●			●			
Conservation of Energy		●	●		●					●		●	●		●			●	●		●	●	●	●
Waves & Electro Magnetic Radiation																								
Sound	●			●	●		●					●		●				●			●		●	
Rectilinear Propagation									●					●					●		●			●
Reflection		●										●	●	●				●	●					●
Refraction		●										●	●	●				●	●					●
Diffraction		●										●	●	●				●	●					●
Interference of Waves	●	●		●								●		●				●	●		●			●
Color/Light-EM Spectrum				●	●				●	●	●	●		●	●			●		●			●	
Polarization	●	●												●				●						
Electricity & Magnetism																								
Electrostatics	●		●			●	●	●	●		●	●		●		●		●	●			●	●	●
Potential Difference	●				●		●	●				●		●				●						
Capacitance	●						●		●		●	●		●				●			●			
Resistance	●								●			●		●				●						
Electric Current	●							●				●		●				●			●			
Electric Circuits	●		●			●						●	●	●				●	●		●	●	●	●
Electric Power	●											●						●			●			
Magnetic Domains							●		●			●		●							●			

Physics Essential Learnings Matrix

(Optional—Cont'd)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Probability	Quantification	Replication	Scale	Space-Time	System	Theory	Validation
Electricity & Magnetism (Cont'd)																								
Magnetic Forces	●						●	●			●	●		●				●			●			
Earth Magnetism							●	●		●	●	●		●				●			●			
Electromagnetism	●						●					●		●	●			●	●		●		●	●
Electromagnetic Induction	●	●		●			●	●				●		●				●			●			
Generators & Motors	●	●		●			●	●				●		●							●			
Inductance	●	●					●		●			●		●				●			●			
Alternating Current	●	●		●			●					●		●				●			●			
Heat																								
Kinetic Theory	●				●			●	●	●		●	●	●	●		●		●		●	●	●	●
Temperature & Scales									●		●							●		●				
Thermodynamics	●	●	●		●	●				●		●		●	●	●		●			●	●	●	●
Specific Heat					●													●						
State Change	●	●			●													●			●			
Gas Laws	●	●						●				●		●				●	●		●	●		●
Thermal Expansion	●	●												●				●			●			
Heat & Work	●	●	●	●	●			●				●						●			●			
Atomic & Nuclear Physics																								
Subatomic Particles					●				●	●		●		●	●			●						
Spectra of Atoms	●				●									●	●		●	●	●					
Photoelectric Effect	●				●							●		●			●	●						
Quantum Physics					●				●	●		●		●	●		●	●	●	●	●	●	●	●
Lasers	●											●		●			●							

Physics Essential Learnings Matrix

(Optional—Cont'd)

	Cause-Effect	Change	Conservation	Cycle	Energy-Matter	Equilibrium	Field	Force	Fundamental Entities	God/Designer/Sustainer	Gradient	Interaction	Invariance	Model	Order	Origins	Probability	Quantification	Replication	Scale	Space-Time	System	Theory	Validation
Atomic & Nuclear Physics (Cont'd)																								
Nature of Radioactivity		●			●									●			●	●	●		●		●	●
Nuclear Reactions	●	●	●		●							●		●	●		●	●			●			
Nuclear Energy Use					●							●						●						
Frontiers of Physics																								
Superconductivity							●					●							●				●	●
Matter/Antimatter		●	●		●				●			●		●									●	
Cosmology/Astronomy					●	●				●		●		●	●	●	●	●			●	●	●	
Miscellaneous																								
Hydrostatics						●		●	●	●	●	●		●				●						
Fluids & Flow						●		●	●			●		●				●			●			
Mixtures						●				●		●						●						