

SCIENCE COURSE OF STUDY

K - 12

2002



Lucia D. McQuaide, Superintendent

Bill Weisner, Director of Curriculum and Instruction

Jeri Rod, Director of School Assessment

Office of Catholic Schools

Catholic Diocese of Columbus

TABLE OF CONTENTS

Introduction, Philosophy, and Program Goals	1
Committee Member	2
Program Options	3
How to Implement the Options	6
Code	7
Content Standards and Objectives	8
Assessment	33

Introduction

Following is the revised K-12 Science Course of Study for the Catholic Diocese of Columbus. In the process of revising the K-12 Science Course of Study, the committee used the Academic Content Standards for the State of Ohio and the National Science Education Standards and Assessment.

Philosophy

We believe the purpose of science education in our Catholic Schools is to facilitate learning so students will actively apply scientific knowledge and skills to contemporary, technological, moral, and social issues. This will be accomplished by recognizing God's design and promoting personal responsibility.

We believe the science curriculum will provide minds-on, as well as hands-on opportunities for students to become scientifically literate. It will also build a foundation for life-long discovery in science as well as other disciplines.

We believe that students have a natural curiosity and appreciation of science. Teachers will encourage these by using the scientific method, providing a variety of learning experiences and assessment strategies, and utilizing various materials, technologies, and community resources.

Program Goals

Students, utilizing a broad-based curriculum, will acquire higher-level thinking skills and in-depth knowledge necessary to solve problems in creative and productive ways.

Students will be able to engage intelligently in public discourse and to debate matters of scientific and technological concern.

Students will use their scientific knowledge, higher level thinking skills, and Catholic values to lead well-balanced and ethical lives.

Students will use scientific literacy to enhance life and career opportunities.

Science Course of Study Committee

Nicole Bowers	Immaculate Conception, Columbus
Theresa Bowser	Bishop Ready High School
Kathleen Costello	Holy Spirit
Linda Cotter	St. Mary, Columbus
Betty Dapollonio	St. Matthias
Wanda Dengel	Notre Dame, Portsmouth
David Eberst	Bishop Watterson High School
Joby Easley	St. Mary, Columbus
Judy Fenlon	St. Andrew
Margie Ford	St. Paul
Diane Gates	St. Timothy
Teresa Gelonese	Our Lady of Peace
Kathy Harbold	St. Mary, Columbus
Gerri Hatch	St. Francis DeSales High School
Suzie Howard	St. Matthew
Valerie Huffman	St. Agatha
Susie Mall	Trinity
Philip Miller	Newark Catholic High School
Jill Money Penny	Immaculate Conception, Columbus
Helen Ortlieb	Bishop Watterson High School
Rebecca Price	Immaculate Conception, Columbus
Kristi Ramsey	St. Cecilia
Kay Ridgeway	Sacred Heart, New Philadelphia
Shannon Roof	Bishop Ready High School
David Rutter	St. Michael
Karen Schwanekamp	Bishop Watterson High School
Catherine Seifert	Bishop Flaget Elementary
Paige Shalter	St. Brigid of Kildare
Fred Smith	Bishop Rosecrans High School
Sharon Stranges	St. Catharine
Robert Telerski	Bishop Hartley High School
Sarah Vandermeer	St. Charles High School

PROGRAM OPTIONS

Grades K-2

Option A – Collaboration Model

Life

Animals
Habitats
Plants

Earth

Water
Space
Geology
Meteorology

Physical

Sound/Light
Matter
Magnetism/Electricity
Heat/Energy

**Grade Specific Model
Option B**

Kindergarten

Animals
Water
Heat/Energy

1st

Habitats
Space
Matter
Meteorology

2nd

Plants
Geology
Magnetism/Electricity
Sound/Light

Grades 3 – 5
Option A - Collaboration Model

Life

Animal Development
Plant Development
Ecosystems
Classifications

Earth

Energy Resources
Water
Pollution
Geology
Meteorology
Space

Physical

Electricity/Magnetism
Forces/Machines
Matter
Light
Sound
Heat

Grade Specific Model
Option B

Third

Plant Development
Meteorology
Space
Matter

Fourth

Animal Development
Water
Geology
Heat
Light
Sound

Fifth

Ecosystems
Classifications
Energy Resources
Pollution
Electricity/Magnetism
Forces/Machines

Grades 6, 7, 8
Option A – Collaboration Model

Life

Botany
Cells
Zoology
Genetics
Ecology
Evolution

Earth

Earth History
Geology
Hydrology
Meteorology
Natural Resources
Space Science

Physical

Chemistry I & II
Light
Sound
Electricity/Magnetism
Force/Motion
Energy Sources

Grade Specific Model
Option B

Sixth

Botany
Cells
Natural Resources
Geology
Light/Sound
Space/Science

Seventh

Zoology
Ecology
Meteorology
Hydrology
Forces Motion
Energy Sources

Eighth

Evolution
Genetics
Earth History
Chemistry I & II
Electricity/Magnetism

How To Implement The Course of Study Options

Option A – Collaboration Model

This option requires all the science teachers and the principal in an elementary building to meet and decide which strands and topics will be taught in the different grades within each grade cluster, K-2, 3-5, 6-8. A school could choose to teach the Life Science strand in one grade, Earth Science in another, and Physical Science another. Another possibility is to integrate the approach in each grade by choosing topics from each of the three strands making certain that all topics are taught by the end of the grade span.

This approach requires a form to be on file at the school office indicating what will be taught at each grade level. It will also require the principal to review the plan at the beginning of each year to ensure that all topics are being covered.

Option B – Grade Specific Model

This option indicates exactly which topics should be taught at each grade level within the grade cluster. No form is required for this choice.

CODE

The Skills in the scope and sequence have been coded as follows:

I - indicates “Introduce” the skill or concept at this grade level.

D - indicates “Develop” the skill by reviewing, extending, and treating it in greater depth than the previous year(s)

M - indicates “Master” the skills. The student will be able to perform the skill or demonstrate an understanding of the concept at an acceptable level.

Content Standard I: Science As Inquiry – (SI)

The student will:

	K	1	2	3	4	5	6	7	8	9	10	11	12			
A. ask questions that can be answered through scientific investigations.	I	D	D	D	D	D	D	D	D/M	M	M	M	M			
B. identify and apply science safety procedures.	I	D	D	D	D	D	D	D	D	D	D	D	D			
C. plan, design, and conduct scientific investigations.			I	D	D	D	D	D	D	D/M	M	M	M			
D. use appropriate tools and technology to gather, analyze, and interpret data.	I	D	D	D	D	D	D	D	D	D	D	D	D			
E. use technology and math to improve investigations and communication.	I	D	D	D	D	D	D	D	D	D	D	M	M			
F. use data to describe events and construct reasonable explanations.	I	D	D	D	D	D	D	D/M	M	M	M	M	M			
G. predict, formulate, and revise scientific explanations and models using logic and evidence.		I	I/D	D	D	D	D	D	D	D	D	D	M			
H. communicate investigations and explanations both orally and/or in written format.	I	D	D	D	D	D	D	D/M	M	M	M	M	M			
I. recognize and analyze alternative explanations, predictions, and models using critical thinking and logical analysis.						I	D	D	D	D	D	D/M	M			
J. defend a scientific argument by logically demonstrating connections among natural phenomena, investigations, and the historic body of scientific knowledge.						I	D	D	D	D/M	M	M	M			

Content Standard II: Inquiry, Unifying Concepts and Processes in Science – (UCPS)

The student will:

	K	1	2	3	4	5	6	7	8	9	10	11	12		
A. observe, compare, and classify objects and organisms by common characteristics.	I	D	D	D	D	D	D	D	D	D	M	M	M		
B. sequence objects and make predictions about missing information.	I	D	D	D	D	D	D	M	M	M	M	M	M		
C. demonstrate an understanding of the inter-relatedness of systems using visual representations.				I	D	D	D	D	D	D	D	D	M		
D. use and apply steps of the scientific method.	I	D	D	D	D	D	D	D	M	M	M	M	M		
E. compare and contrast mass, dimension, and volume of familiar objects and organisms.	I	D	D	D	D	D	D	D	D	D	D	M	M		
F. select and use appropriate materials, measuring devices, and tools to conduct investigation.		I	I/D	D	D	D	D	D	M	M	M	M	M		
G. recognize that some characteristics and properties remain constant while others change in varying trends and cycles.		I	I/D	D	D	D	D	D	D	D	D	D	M		
H. explore influences and interactions of objects/organisms.	I	D	D	D	D	D	D	D	D	D	M	M	M		
I. compare and contrast diverse structures and their associated functions.			I	D	D	D	D	D	D	D	D	D	M		
J. recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms, and systems.				I	D	D	D	D	D	D	M	M	M		

Content Standard III: Science In Personal and Social Perspectives – (SPSP)

The student will:

	K	1	2	3	4	5	6	7	8	9	10	11	12			
A. recognize the interrelationships of science and health in personal health issues.	I	D	D	D	D	D	D	D	D	D	D	D	M			
B. identify characteristics and changes in population.	I	D	D	D	D	D	D	D	D	D	D	M	M			
C. identify, define, and integrate natural resources.	I	D	D	D	D	D	M	M	M	M	M	M	M			
D. explore environmental changes and their consequences.	I	D	D	D	D	D	D	D	M	M	M	M	M			
E. make personal and social decisions based on analysis of environmental risks and benefits.				I	D	D	D	M	M	M	M	M	M			
F. apply Catholic values to development and application of science and technology.	I	D	D	D	D	D	D	D	D	D	D	D	D			
G. develop an awareness of life and career opportunities in science and technology.	I	D	D	D	D	D	D	D	D	M	M	M	M			
H. apply scientific and technological literacy to debate local, national, or global challenges and potential solutions.						I	D	D	D	D	D	D	D			
I. understand that many people have contributed to the body of scientific knowledge.	I	D	D	D	D	D	D	D	D	M	M	M	M			
J. understand the historical development of science and how it affects the issues of today’s world.				I	D	D	D	D	D	M	M	M	M			

Content Standard IV: Life Science - (LS)

The student will:

	K-2	3-5	6-8	H. S.
A. classify and compare characteristics of organisms.	I/D	D	D	M
B. observe and identify the cell as the basic unit of life.		I/D	D/M	M
C. investigate and explain the relationship between cell structure and function.		I/D	D	D/M
D. investigate and explain internal and external influences on an organism's behavior.	I/D	D	D	D/M
E. distinguish among the patterns of reproduction.		I	D	D/M
F. differentiate between inherited characteristics and environmental characteristics.	I	D	D	D/M
G. understand the transmission of genetic information to offspring.	I	I/D	D	D/M
H. investigate and identify various components of ecosystems and their interdependence.	I/D	D	D	D/M
I. observe and explain the role of energy and matter in the biosphere and the laws and processes that govern their interaction.			I/D	D/M

Content Standard V: Earth and Space Science – (ESS)

The student will:

	K-2	3-5	6-8	H.S.
A. identify and describe different types of materials in the lithosphere.	I/D	D	D/M	M
B. describe natural changes, structure, formation and history of the lithosphere.	I	D	D/M	M
C. identify the importance and uses of water.	I/D	D	D	M
D. identify the properties of water.	I/D	D	D	M
E. describe the water cycle.	I/D	D	D/M	M
F. investigate and describe the impact of water on the lithosphere.	I	D	D/M	M
G. compare and contrast climate, weather and seasons.	I	D	D/M	M
H. investigate solar energy and its effects.	I	D	M	M
I. identify the members of the solar system and investigate the motion and relationship among them.	I	D	D/M	M
J. investigate the formation, structure and motion of components of the universe.		I/D	D/M	M
K. investigate the development of the space program and space exploration.	I	D	D/M	M
L. identify and evaluate the importance of renewable and non-renewable resources and their conservation.	I/D	D	D/M	M
M. identify the sources, effects, and prevention of pollution.	I/D	D	D/M	M

Content Standard VI: Physical Science – (PS)

The student will:

	K-2	3-5	6-8	H.S.
A. observe, describe, and compare physical properties of objects and materials.	I/D	D	D/M	M
B. observe, describe, and compare chemical properties of objects and materials.	I	D	D	D/M
C. devise and use a classification system for objects based on their properties.	I/D	D	D/M	M
D. recognize and investigate the states of matter.	I/D	D	D/M	M
E. observe, describe, and investigate that substances react in characteristic ways with other substances to form new substances (compounds).		I/D	D	D/M
F. investigate and compare elements, atoms, molecules and compounds.		I/D	D	D/M
G. observe, investigate, and describe the laws of motion.	I	D	D	D/M
H. observe and investigate forms of energy.	I/D	D	M	M
I. observe and investigate the interactions between matter and energy and the laws and processes that govern them.				
1) sound and light	I	D	D/M	M
2) magnetism and electricity	I	D	D/M	M
3) heat	I	D	D/M	M
4) nuclear		I	D	D/M

HIGH SCHOOL

The following pages contain objectives for high school courses that are to be used in conjunction with Contents I through VI. Content standards I, II and III must be used because those objectives integrate with all science courses in grades K-12. Content standards IV, V, and VI contain objectives that are basic to the ones on the pages that follow.

ENVIRONMENTAL SCIENCE (EVS)

A. The student will develop techniques in thinking and problem-solving skills and be able to:

1. use appropriate scientific vocabulary in the communication of scientific ideas;
2. discuss current issues in environmental sciences;
3. draw valid conclusions from collected data;
4. convert a question into a testable hypothesis;
5. use scientific data and graphs to make predictions;
6. make valid conclusions from scientific data;
7. research an environmental issue in a problem solving way utilizing library sources, internet resources, government agencies, private environmental groups, experiments, and interviews;
8. recognize and identify statutes, regulations, and agencies dealing with pollution, health and safety issues;
9. make a decision on an environmental issue based on scientific, economic, political, and ethical information learned in the course and present it to the class;
10. list ways one could help prevent and solve environmental problems;

11. conclude that the Earth has finite resources and explain that humans deplete some resources faster than they can be renewed;
12. explain the interrelationships between organisms in the biosphere;
13. explain how human behavior affects the basic processes of natural ecosystems and the quality of the atmosphere, hydrosphere and lithosphere;
14. explain the role of energy and matter in the biosphere (atoms, molecules, elements, compounds) and the law (conservation, thermodynamics, tolerance, minimum) and processes (photosynthesis and respiration) that govern their interaction;
15. explain the importance of ecosystem stability and the concepts that are involved such as environmental resistance, biotic potential, succession, individual plant and animal characteristics and human intervention, and extinction of species;
16. identify the major biomes on earth and the type of organisms that live there;
17. differentiate between threatened and endangered species and research the laws pertaining to both;
18. analyze the role of extinction in the balance of nature and formulate a position on whether or not we should save a particular species;
19. examine the destruction of various habitats and the reasons for such destruction;
20. identify the fossil fuels and distinguish between renewable and non-renewable resources;
21. explore uses of fossil fuels and methods of conservation;
22. examine alternate energy sources and the feasibility of their uses;
23. identify land management techniques and possible ways we may feed our population in the future;
24. develop an understanding of the shortage of fresh water and possible new sources for this resource.

BIOLOGY (B)

Note: All courses offered with Biology in the title must be based on objectives from those listed below.

A. The student will develop techniques in thinking and problem-solving skills:

1. use appropriate scientific vocabulary in the communication of scientific ideas;
2. discuss current issues in bioethics;
3. draw valid conclusions from collected data;
4. use both research and technical methods for solving problems;
5. understand and use the metric measurement system;
6. apply scientific method to problems in biology.

B. The student will develop a mastery of specific content material:

1. understand how chemistry relates to living organisms;
2. understand the structure and function of biochemical molecules in relation to human organisms;
3. understand the structure, functions and variations of cells;

4. understand the cell theory;
5. identify cell organelles and explain their functions;
6. explain and identify stages of cell division;
7. distinguish among cells, tissues, organs, and systems;
8. describe cellular reproduction;
9. understand traditional and modern genetics;
10. solve genetic problems;
11. understand, in general, the historical importance of leading scientists and their contributions;
12. describe modern genetics research such as genetic engineering, genome mapping, cloning, stem cell research;
13. describe Darwin's Theory of Natural Selection and other theories of evolution;
14. recognize the major life processes as carried out by diverse groups of organisms;
15. describe the basis of classification and identify major taxonomic groups;
16. explain the structure, function, maintenance and control of selected mammalian/human organ systems;
17. describe the structure and function of generalized plants;
18. explain plant processes, i.e. photosynthesis, transpiration, etc.;

19. develop an understanding of ecological relationships.

C. The student will develop and demonstrate appropriate laboratory skills:

1. identify and correctly use laboratory equipment;
2. collect, record and analyze data;
3. practice laboratory safety procedures.

INTEGRATED SCIENCE (IS)

A. The student will develop problem-solving skills and be able to:

1. use a calculator and appropriate formula to solve problems related to:
 - a. metric conversions;
 - b. linear motion;
 - c. work and power;
 - d. molecular weight and % composition;
 - e. population density.
2. use other technologies to gather, analyze, and interpret data.

B. The student will master specific content matter by:

1. understanding basic principles of ecology and being able to:
 - a. identify parts of an ecosystem;
 - b. define and give examples of food chains and webs;
 - c. identify the roles of producers, consumers and decomposers in a food chain;
 - d. identify limiting factors in an ecosystem;
 - e. describe succession;
 - f. identify some plant and animal adaptations;
 - g. explain how climate effects biomes;
 - h. describe the features of major land and aquatic biomes.
2. understanding some basic principles of chemistry and being able to:
 - a. describe physical and chemical properties of matter;

- b. differentiate the three phases of matter;
 - c. differentiate between physical and chemical changes;
 - d. define elements, mixtures and compounds;
 - e. define atoms and molecules;
 - f. identify subatomic particles and describe the Bohr atomic model;
 - g. differentiate between symbols and formulas;
 - h. use the Bohr model to illustrate ionic and covalent bonding;
 - i. describe the properties and uses of some families of atoms;
 - j. describe and give examples of oxidation-reduction and acid-base reactions;
 - k. define pH and use pH to describe relative strength of acids and bases;
 - l. describe radioactivity, types of radiation, half-life and some uses of radioactivity.
3. understanding some basic concepts of geology, weather and astronomy and being able to:
- a. define minerals and explain how they are identified;
 - b. identify three classes of rocks;
 - c. define fossils and describe their importance;
 - d. describe the water-cycle and its variations;
 - e. define weathering and list some factors that affect it;
 - f. describe the formation of soil;
 - g. define and list the agents of erosion;
 - h. describe plate tectonics, earthquakes and volcanoes;
 - i. describe the layers of the atmosphere;
 - j. define wind and explain its causes;
 - k. describe several forms of precipitation;
 - l. discuss factors used in predicting weather;
 - m. describe the rotation and revolution of the earth;
 - n. identify the general features of the moon and the planets of the solar system;
 - o. describe the properties of the sun and stars;
 - p. compare lunar and solar eclipses.
4. understanding some fundamental principles of physics and being able to:

- a. describe motion, velocity and acceleration;
 - b. explain forces and identify major forces affecting motion;
 - c. state and give examples of Newton's Laws of Motion;
 - d. describe the theory of universal gravitation;
 - e. explain and give examples of work, power and energy;
 - f. differentiate between potential and kinetic energy;
 - g. explain simple machines and give examples of each type;
 - h. differentiate between heat and temperature;
 - i. describe some effects of heat and how heat is transferred;
 - j. explain static and current electricity;
 - k. describe the nature and properties of sound and light.
5. understanding some basic concepts of life science and being able to:
- a. use appropriate scientific vocabulary;
 - b. understand cell theory, their structure, function and variations;
 - c. explain cell division and identify the stages
 - d. describe how cells and organisms acquire and release energy;
 - e. relate diversity and adaptation to structures and their functions in living organisms;
 - f. explain that natural selection leads to organisms that are well suited for survival in a particular environment;
 - g. explain that a gene is a unit of heredity and occurs in different forms;
 - h. describe advances in life sciences that have important long lasting effects on science and society;
 - i. explain how living things interact with biotic and abiotic components of the environment.

CHEMISTRY

Note: All courses offered with Chemistry in the title must be based on objectives from those listed below.

BASIC CHEMISTRY OBJECTIVES (BCO)

The student will be able to:

1. identify and apply the philosophy of the scientific method, and the way in which the method determines the nature of scientific discovery;
2. apply, demonstrate, and conduct metric system measurements in experimental and calculation situations;
3. apply the principle of density to lab and problem-solving situations;
4. apply the laws of conservation of matter, energy, and mass energy to problem-solving situations;
5. understand and apply atomic theory in describing the properties of the elements;
6. understand and apply wave-particle theory to the description of the atom;
7. understand and apply quantum theory as it is used to describe the atom;
8. use the electron structure and electron configuration of the atom to explain periodic properties of the elements;
9. distinguish among elements, compounds, mixtures, and list the properties of each;
10. determine and write empirical and molecular formulas of compounds;

11. predict the products of chemical reactions, and balance the resulting equations;
12. apply mole theory and Avogadro's number in stoichiometric problems;
13. understand the history of the development of the periodic table;
14. predict the physical and chemical properties of the elements by using the periodic table;
15. predict oxidation numbers and determine chemical formulas by using the periodic table;
16. explain and apply the periodic trends in electro-negativity, ionization energy, electron affinity, and atomic radius to the properties of the elements;
17. understand the interactions that lead to the formation of chemical bonds and the intermolecular forces resulting from their formation;
18. explain the significance of the octet rule and draw Lewis dot structures;
19. differentiate among ionic bonds, non-polar covalent bonds, and polar-covalent bonds;
20. apply the kinetic molecular theory to describe the three states of matter and the inter-conversion between states;
21. understand crystal structure as it relates to properties of solids; be able to identify the seven crystal systems and differentiate among them;
22. make use of phase diagrams to explain state changes for a substance, including an explanation of the concepts of triple point, critical temperature, critical pressure, and sublimation;
23. use phase diagrams to explain the concept of normal boiling points and melting points;

24. apply the kinetic molecular theory of gases to lab and problem-solving situations;
25. solve problems dealing with the gaseous state of matter and changes in the parameters of the ideal gas law;
26. define enthalpy and entropy and explain their relationships to exothermic and endothermic reactions; apply the concepts of free energy, chemical change, and internal energy to thermodynamic problems;
27. apply the principles of solution chemistry to lab and problem-solving situations;
28. apply acid base theories (Arrhenius, Bronsted-Lowry, and Lewis) to describe and determine acid-base strengths, equilibrium constants, common ion effect, pH scale, and indicators;
29. explain orally, in written form, and graphically the principles of reaction rate chemistry;
30. explain the concept of systems at equilibrium and be able to apply Le Chatelier's principle to all equilibrium situations;
31. relate the concept of free energy to Le Chatelier's principle and to systems of equilibrium and the equilibrium constant;
32. define and give examples of oxidation and reduction, and oxidizing and reducing agents;
33. balance equations using redox methods;
34. write equations for electrochemical reactions (cathode and anode equations).

ADDITIONAL CHEMISTRY OBJECTIVES (ACO)
FOR HONORS OR A.P.

The student will be able to:

1. define half-life and give examples of its use;

2. describe and give examples of fusion, fission, and other natural and man-made atomic reactions;
3. explain the hybridization of orbitals and the MO theory;
4. list and classify hydrocarbons and draw structural formulas for them;
5. name the saturated and unsaturated carbon compounds;
6. understand isomerization in organic compounds;
7. describe the properties of atomic nuclei of radioactive atoms;
8. list and classify elementary particles;
9. define the relationship between cell potential and pH, and between cell potential and free energy.

EARTH SCIENCE (ES)

A. The student will develop a mastery of specific content material by:

1) understanding the principles that affect the lithosphere through:

- a) identifying various minerals in the earth;
- b) identifying the three main types of rock and describe how they formed;
- c) knowing the methods used to determine a timetable for the earth's history;
- d) knowing the theory of Plate Tectonics and its relationship to the movement of the crust;
- e) understanding volcanism as a force that builds the crust ;
- f) understanding the effects of weathering on earth materials;
- g) knowing how the forces of erosion change the earth surface.

2) understanding the principles that affect the atmosphere through:

- a) exploring the composition of the earth's atmosphere;
- b) understanding the relationship between the temperature and the atmosphere;
- c) investigating the effects of air pressure on the atmosphere;
- d) investigating wind, its causes, and its effect on weather;
- e) understanding air masses and their effects on weather.

3) understanding the principles that affect the hydrosphere by:

- a) investigating the earth's five oceans;
- b) investigating surface and ground water;
- c) understanding the relationships between the oceans and the lithosphere and atmosphere.

- 4) understanding the principles of the universe by:
 - a) examining the tools of the astronomers;
 - b) examining the stars and galaxies of the universe;
 - c) investigating the solar system;
 - d) investigating the moon and motions of the earth's moon system;
 - e) exploring the possible origins of the universe;
 - f) gaining an overview of the exploration of space.
- 5) understanding how human activity affects the physical and chemical cycles of the earth.
- 6) being able to describe advances in earth science that have had important long lasting effects on society and science.

ANATOMY AND PHYSIOLOGY (AnPh)

A. The student will develop techniques in thinking and problem-solving skills and be able to:

1. use appropriate scientific vocabulary in the communication of scientific ideas;
2. discuss current issues in bioethics;
3. read life science articles in periodicals and write critiques of them;
4. draw valid conclusions from collected data;
5. use both research and technical methods for solving problems;

B. The student will develop a mastery of specific content material by being able to:

1. define anatomy and physiology and explain how they re related;
2. describe and locate the major body cavities and contents of each;
3. define some medical and applied science fields of study and careers;
4. compare characteristics, functions, and locations of connective tissues, muscle tissues, epithelial tissues, and nerve tissues;
5. describe the structure and function of the skeletal system, including classification, identification, and functions or the bones and their parts;

6. describe the structure and function of the muscular system, including the classification, identification, and contraction mechanism of skeletal muscles;
7. compare the organs of the digestive system, as well as its enzymes and possible disorders;
8. describe organs of the respiratory system and the physiology of gas exchange and transport;
9. explain the structure and functions of the organs of the urinary system;
10. describe the characteristics of blood and its functions, including its components, production, and repair;
11. explain the structure and function of the heart and blood vessels in the circulatory system;
12. explain and identify the structure and function of the central and peripheral nervous system and its parts, including the physiology of nerve impulse conduction;
13. describe the structure and functions of the hearing and vision sensory systems;
14. explain structure and functions of male and female reproductive systems, including hormone control, pregnancy and birth, and fetal circulation;
15. describe the structures of membranes and the integumentary system and functions;
16. explain and identify the structure and function of the immune system;
17. explain and identify the structure and function of the endocrine system.

PHYSICS (P)

Note: All courses offered with Physics in the title must be based on the following:

The student will:

1. understand kinematics as related to speed and velocity and be able to apply the concepts;
2. understand kinematics as related to acceleration and be able to solve problems;
3. understand Newton's laws and be able to use them in problem solving;
4. be able to identify and apply the concepts of potential and kinetic energy;
5. be able to use the theory of conservation of energy to solve problems;
6. understand the concept of heat and thermal energy;
7. explore the concepts of centripetal force and gravity;
8. understand fluid statics;
9. understand the concepts of magnetism and magnetic fields;
10. gain a basic understanding of relativity;

11. gain an understanding of the Quantum Theory;
12. explore and gain a basic understanding of the area of nuclear physics;
13. gain an understanding of electrostatics;
14. understand direct current and circuits and be able to:
 - a) apply Ohm's Law
 - b) solve problems relating to series or parallel circuits
15. understand the concepts of harmonic motion and elasticity;
16. understand sound waves and light waves and be able to problem solve using that knowledge;
17. understand the concepts of momentum and collisions;
18. gain a basic knowledge of rotational motion and be able to apply the knowledge through problem solving.

ASSESSMENT

We make the following assumptions when we evaluate:

- instruction and assessment are closely linked;
- good teachers constantly assess students informally and formally;
- teaching science for understanding rests in the teacher's ability to explore topics in ways that promote critical thinking;
- assessments embedded in instruction are important sources of information for instructional and intervention decisions made by teachers and other members of the educational community;
- students must be part of goal setting and evaluation, with self-assessment a vital part of learning;
- formal assessments are stronger if they reflect the content and form of classroom instruction;
- documentation of assessment is important in connecting classroom work to external evaluation.

Assessment techniques may include, but are not limited to:

- traditional tests (objective/subjective);
- quizzes;
- projects (groups and individual);
- problem solving simulations;
- homework and classwork;
- discussion;
- teacher observations;
- self and peer evaluation;
- pupil-Teacher conferences;
- journals;
- student presentations;
- essays;
- research based reports.

Kindergarten – Science Standards

Standard I: Science as Inquiry

- A. Ask “what if” questions. I-A
- B. Explore and pursue student-generated “what if” questions. I-A
- C. Use appropriate safety procedures when completing scientific investigations. I-B
- D. Use the five senses to make observations about the natural world. I-C
- E. Draw pictures that correctly portray features of the items being described. I-G
- F. Recognize that numbers can be used to count a collection of things. I-D
- G. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools).
- H. Measure the lengths of objects using non-standard methods of measurement (e.g., teddy bear counters, pennies). I-C
- I. Make pictographs and use them to describe observations and draw conclusions. I-C
- J. Make new observations when people give different descriptions for the same thing. I-F
- K. *Use technology and math to improve investigations and communication. I-E*
- L. *Use data to describe events and construct reasonable explanations. I-F*
- M. *Communicate investigations and explanations both orally and/or in written format. I-H*

Benchmarks for Standard I: K-2

- A. Ask a testable question.**
- B. Design and conduct a simple investigation to explore a question.**
- C. Gather and communicate information from careful observations and simple investigation through a variety of methods.**

Standard II, III: Inquiry, Unifying Concepts and Processes in Science, and Science in

Personal and Social Perspectives

- A. Explore that objects can be sorted as “natural” or “man-made”. II-A, V-L
- B. Explore that some materials can be used over and over again (e.g., plastic or glass containers, cardboard boxes and tubes). V-L
- C. Explore that each kind of tool has intended use, which can be helpful or harmful (e.g., scissors can be used to cut paper but they can also hurt you). I-C
- D. Recognize that scientific investigations involve asking open-ended questions. (How? What if?) I-A
- E. Recognize that people are more likely to accept your ideas if you can give good reasons for them. I-E, G
- F. Interact with living things and the environment in ways that promote respect. III-F, IV-H
- G. Demonstrate ways science is practiced by people everyday (children and adults). III-A, G
- H. *Sequence objects and make predictions about missing information. II-B*
- I. *Compare and contrast mass, dimension and volume of familiar objects and organisms. II-E*
- J. *Explore influences and interactions of objects/organisms. II-H*
- K. *Identify characteristics and changes in population. III-B*
- L. *Identify, define and integrate natural resources. III-C*
- M. *Explore environmental changes and their consequences. III-D*

Benchmarks for Standards II, III: K, 2

- A. Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.**
- B. Explain that to construct something requires planning, communication, problem solving and tools.**

- C. Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.**
- D. Recognize the importance of respect for all living things.**
- E. Recognize that diverse groups of people contribute to our understanding of the natural world.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- **Bolded statements after each standard are state benchmarks for the grade span.**

Grade 1 – Science Standards

Standard I: Science as Inquiry

- A. Ask “what happens when” questions. I-A
- B. Explore and pursue student-generated “what happens when” questions. I-A
- C. Use appropriate safety procedures when completing scientific investigations. I-B
- D. Work in a small group to complete an investigation and then share findings with others. I-B, G
- E. Create individual conclusions about group findings. I-E
- F. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, timers, simple balances and other appropriate tools). I-C
- G. Make estimates to compare familiar lengths, weights and time intervals. I-D
- H. Use oral, written and pictorial representation to communicate work. I-G
- I. Describe things as accurately as possible and compare with the observations of others. I-F, G
- J. *Communicate investigations and explanations both orally and /or in written form. I-J*

Benchmarks for Standard I: K-2

- A. Ask a testable question.**
- B. Design and conduct a simple investigation to explore a question.**
- C. Gather and communicate information from careful observations and simple investigation through a variety of methods.**

Standard II, III: Inquiry, Unifying Concepts, and Processes in Science and Science in Personal and Social Perspectives

- A. *Observe, compare, and classify objects and organisms by common characteristics. II-A*

- B. *Compare and contrast mass dimension and volume of familiar objects and organisms. II-F*
- C. *Select and use appropriate materials, measuring devices and tools to conduct investigation. II-F*
- D. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles.*
- E. *Recognize the interrelationships of Science and Health in personal health issues. III-A*
- F. *Identify characteristics and changes in population. III-B*
- G. *Identify, define and integrate natural resources. III-C*
- H. *Explore environmental changes and their consequences. III-D*
- I. Discover that when a science investigation is done the same way multiple times, one can expect to get very similar results each time it is performed. II-D
- J. Demonstrate good explanations based on evidence from investigations and observations. I-E
- K. Explain that everybody can do science, invent things and have scientific ideas no matter where they live. III-G
- L. Explore that some kinds of materials are better suited than others for making something new (e.g., building materials used in the *Three Little Pigs*). III-A
- M. Explain that when trying to build something or get something to work better, it helps to follow directions and ask someone who has done it before. LA-III-E, S
- N. Identify some materials that can be saved for community recycling projects (e.g., newspapers, glass and aluminum). V-L
- O. Explore ways people use energy to cook their food and warm their homes (e.g., wood, coal, natural gas, electricity). VI-I
- P. Identify how people can save energy by turning things off when they are not using them (e.g., lights and motors). V-L, III-F
- Q. Investigate that tools are used to help make things and some things cannot be made without tools. I-C, LA-III-E, S

- R. Explore that several steps are usually needed to make things (e.g., building with blocks). II-B
- S. Investigate that when parts are put together they can do things that they could not do by themselves(e.g., blocks, gears and wheels).II-H

Benchmarks for Standards II, III: K, 2

- A. Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.**
- B. Explain that to construct something requires planning, communication, problem solving and tools.**
- C. Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.**
- D. Recognize the importance of respect for all living things.**
- E. Recognize that diverse groups of people contribute to our understanding of the natural world.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 2 – Science Standards

Standard I: Science as Inquiry

- A. Ask “how can I/we” questions. I-A
- B. Ask “how do you know” questions (not “why” questions) in appropriate situations and attempt to give reasonable answers when others ask questions.
- C. Explore and pursue student-generated “how” questions. I-A
- D. Use appropriate safety procedures when completing scientific investigations. I-B
- E. Use evidence to develop explanations of scientific investigations. (What do you think? How do you know?) I-E
- F. Recognize that explanations are generated in response to observations, events and phenomena. I-E
- G. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances, calculators and other appropriate tools). I-C
- H. Measure properties of objects using tools such as rulers, balances and thermometers. I-C
- I. Use whole numbers to order, count, identify, measure and describe things and experiences. I-D
- J. Share explanations with others to provide opportunities to ask questions, examine evidence and suggest alternative explanations. I-G
- K. *Use data to describe events and construct reasonable explanations. I-F*
- L. *Communicate investigations and explanations both orally and/or in written format. I-H*

Benchmarks for Standard I: K-2

- A. Ask a testable question.**
- B. Design and conduct a simple investigation to explore a question.**
- C. Gather and communicate information from careful observations and simple investigation through a variety of methods.**

Standard II, III: Inquiry, Unifying Concepts, and Processes in Science and Science in Personal and Social Perspectives

- A. Explain that developing and using technology involves benefits and risks. I-C
- B. Investigate why people make new products or invent new ways to meet their individual wants and needs. III-A
- C. Predict how building or trying something new might affect other people and the environment. II-H
- D. Communicate orally, pictorially, or in written form the design process used to make something. I-B, G
- E. Describe that scientific investigations generally work the same way under the same conditions. II-D
- F. Explain why scientists review and ask questions about the results of other scientist’s work. I-A, E
- G. Describe ways in which using the solution to a problem might affect other people and the environment. III-A, D, II-H
- H. Demonstrate that in science it is helpful to work with a team and share findings with others. I-G
- I. *Sequence objects and make predictions about missing information. II-B*
- J. *Select and use appropriate materials, measuring devices and tools to conduct an investigation. II-F*
- K. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- L. *Compare and contrast diverse structures and their associated functions. II-I*
- M. *Identify characteristics and changes in population. III-B*
- N. *Identify, define and integrate natural resources. III-C*
- O. *Explore environmental changes and their consequences. III-D*
- P. *Apply Catholic values to development and application of science and technology. III-F*

- Q. *Develop an awareness of life and career opportunities in science and technology. III-G*

Benchmarks for Standards II, III: K, 2

- A. Explain why people, when building or making something, need to determine what it will be made of, how it will affect other people and the environment.**
- B. Explain that to construct something requires planning, communication, problem solving and tools.**
- C. Recognize that there are different ways to carry out scientific investigations. Realize that investigations can be repeated under the same conditions with similar results and may have different explanations.**
- D. Recognize the importance of respect for all living things.**
- E. Recognize that diverse groups of people contribute to our understanding of the natural world.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 3 – Science Standards

Standard I: Science as Inquiry

- A. *Ask questions that can be answered through scientific investigations. I-A*
- B. *Use data to describe events and construct reasonable explanations. I-F*
- C. *Communicate investigations and explanations both orally and/or in written format. I-H*
- D. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units. I-B, C, D
- E. Discuss observations and measurements made by other people. I-G
- F. Read and interpret simple tables and graphs produced by self/others. I-E
- G. Identify and apply science safety procedures. I-B
- H. Record and organize observations (e.g., journals, charts, tables). I-G
- I. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations). I-G

Benchmarks for Standard I: 3-5

- A. Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.**
- B. Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.**
- C. Develop, design and safely conduct scientific investigations and communicate the results.**

Standard II, III: Inquiry, Unifying Concepts, and Processes in Science and Science in Personal and Social Perspectives

- A. *Observe, compare, and classify objects and organisms by common characteristics. II-A*

- B. *Sequence objects and make predictions about missing information. II-B*
- C. *Demonstrate an understanding of the interrelatedness of systems using visual representations. II-C*
- D. *Compare and contrast mass, dimension and volume of familiar objects and organisms. II-E*
- E. *Select and use appropriate materials, measuring devices and tools to conduct investigations. II-F*
- F. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- G. *Explore influences and interactions of objects and organisms. II-H*
- H. *Compare and contrast diverse structures and their associated functions. II-I*
- I. *Recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms and systems. II-J*
- J. *Identify, define and integrate material resources. III-C*
- K. Describe different kinds of investigations that scientists use depending on the questions they are trying to answer. I-A
- L. Keep records of investigations and observations and do not change the records that are different from someone else's work. I-E, B : II-D
- M. Explore through stories how men and women have contributed to the development of science. III-G
- N. Identify various careers in science. III-G
- O. Discuss how both men and women find science rewarding as a career and in their everyday lives. III-G
- P. Describe how technology can extend human abilities (e.g., to move things, to extend senses). III-A, G
- Q. Describe ways that using technology can have helpful and/or harmful results. III-F, E, D
- R. Investigate ways that the results of technology may affect the individual, family and community. III-A, B, D, E, G

- S. Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions, design a solution). I-B, C, D
- T. Describe possible solutions to a design problem (e.g., how to hold down paper in the wind). I-G

Benchmarks for Standards II, III: 3-5

- A. Describe how technology affects human life.**
- B. Describe and illustrate the design process.**
- C. Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.**
- D. Describe different types of investigations and use results and data from investigations to provide the evidence to support explanations and conclusions.**
- E. Explain the importance of keeping records of observations and investigations that are accurate and understandable.**
- F. Explain that men and women of diverse countries and cultures participate in careers in all fields of science.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- **Bolded statements after each standard are state benchmarks for the grade span.**

Grade 4 – Science Standards

Standard I: Science as Inquiry

- A. *Ask questions that can be answered through scientific investigations. I-A*
- B. *Use technology and math to improve investigations and communications. I-E*
- C. *Communicate investigations and explanations both orally and/or in written format. I-H*
- D. Select the appropriate tools and use relevant safety procedures to measure and record length, weight, volume, temperature and area in metric and English units. I-B, C
- E. Analyze a series of events and/or simple daily or seasonal cycles, describe the patterns and infer the next likely occurrence. I-F
- F. Develop, design and conduct safe, simple investigations or experiments to answer questions. I-B, C, D
- G. Explain the importance of keeping conditions the same in an experiment. I-B, II-D
- H. Describe how comparisons may not be fair when some conditions are not kept the same between experiments. II-D
- I. Formulate instructions and communicate data in a manner that allows others to understand and repeat an investigation or experiment. I-G

Benchmarks for Standard I: 3-5

- A. Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.**
- B. Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.**
- C. Develop, design and safely conduct scientific investigations and communicate the results.**

Standard II, III: Inquiry, Unifying Concepts, and Processes in

Science and Science in Personal and Social Perspectives

- A. *Observe, compare and classify objects and organisms by common characteristics. II-A*
- B. *Demonstrate an understanding of the interrelatedness of systems using visual representations. II-C*
- C. *Compare and contrast mass, dimension and volume of familiar objects and organisms. II-E*
- D. *Compare and contrast diverse structures and then associated functions. II-I*
- E. *Recognize that evolution is change over time and that it accounts for the present form and function of objects, organisms and systems. II-J*
- F. *Identify characteristics and changes in populations. III-B*
- G. *Identify, define and integrate natural resources. III-C*
- H. Differentiate fact from opinion and explain that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed. II-D, F; LA III F-1
- I. Record the results and data from an investigation and make a reasonable explanation. II-G, F; I-E, G
- J. Explain discrepancies in an investigation using evidence to support findings. II-D; I-E, G
- K. Explain why keeping records of observations and investigations are important. I-B
- L. Explain how technology from different areas (e.g., transportation, communication, nutrition, healthcare, agriculture, entertainment, manufacturing) has improved human lives. II-C, G, H; III-A, D, E, F, G
- M. Investigate how technology and inventions change to meet peoples' needs and wants. III-A, D, E, F, G; See Soc. Stud.-G, A
- N. Describe, illustrate and evaluate the design process used to solve a problem. II-B, D; I-B, C, D, E, F, G

Benchmarks for Standards II, III: 3-5

- A. Describe how technology affects human life.**
- B. Describe and illustrate the design process.**
- C. Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.**
- D. Describe different types of investigations and use results and data from investigations to provide the evidence to support explanations and conclusions.**
- E. Explain the importance of keeping records of observations and investigations that are accurate and understandable.**
- F. Explain that men and women of diverse countries and cultures participate in careers in all fields of science.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- **Bolded statements after each standard are state benchmarks for the grade span.**

Grade 5 – Science Standards

Standard I: Science as Inquiry

- A. Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools). I-B, C, D
- B. Evaluate observations and measurements made by other people and identify reasons for any discrepancies. I-C, H
- C. Use evidence and observations to explain and communicate the results of investigations. I, G
- D. Identify one or two variables in a simple experiment. I, C
- E. Identify potential hazards and/or precautions involved in an investigation. I-B
- F. Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations). I-E, F, H
- G. *Ask questions that can be answered through scientific investigations. I-A*
- H. *Recognize and analyze alternate explanations, predictions, and models using critical thinking and logical analysis. I-I*
- I. *Defend a scientific argument by logically demonstrating connections among natural phenomena, investigations, and the historic body of scientific knowledge. I-J*

Benchmarks for Standard I: 3-5

- A. Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.**
- B. Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.**
- C. Develop, design and safely conduct scientific investigations and communicate the results.**

Standard II, III: Inquiry, Unifying Concepts and Processes in

Science, and Science in Personal and Social Perspectives

- A. Summarize how conclusions and ideas change as new knowledge is gained. I-B, C, F, G
- B. Develop descriptions, explanations and models using evidence to defend/support findings. I-G
- C. Explain why an experiment must be repeated by different people or at different times or places and yield consistent results before the results are accepted. II-D
- D. Identify how scientists use different kinds of ongoing investigations depending on the questions they are trying to answer (e.g., observations of things or events in nature, data collection, controlled experiments). I-A
- E. Keep records of investigations and observations that are understandable weeks or months later. I-B, E
- F. Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform. III-G
- G. Investigate positive and negative impacts of human activity and technology on the environment. III-A, D, F, G, E
- H. Revise an existing design used to solve a problem based on peer review. I-B, C, D, E, F, G, H
- I. Explain how the solution to one problem may create other problems. I-H, II-H
- J. *Observe, compare, and classify objects and organisms by common characteristics. II-A*
- K. *Sequence objects and make predictions about missing information. II-B*
- L. *Demonstrate an understanding of the interrelatedness of systems using visual representations. II-C*
- M. *Compare and contrast mass, dimension, and volume of familiar objects and organisms. II-E*
- N. *Select and use appropriate materials, measuring devices, and tools to conduct investigation. II-F*
- O. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- P. *Explore influences and interactions of objects/organisms. II-H*
- Q. *Compare and contrast diverse structures and their associated functions. II-I*

- R. *Recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms, and systems. II-J*
- S. *Identify characteristics and changes in population. III-B*
- T. *Identify, define, and integrate natural resources. III-C*
- U. *Apply scientific and technological library to debate local, national, or global challenges and potential solutions. III-H*

Benchmarks for Standards II, III: 3-5

- A. Describe how technology affects human life.**
- B. Describe and illustrate the design process.**
- C. Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.**
- D. Describe different types of investigations and use results and data from investigations to provide the evidence to support explanations and conclusions.**
- E. Explain the importance of keeping records of observations and investigations that are accurate and understandable.**
- F. Explain that men and women of diverse countries and cultures participate in careers in all fields of science.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- **Bolded statements after each standard are state benchmarks for the grade span.**

Grade 6 – Science Standards

Standard I: Science as Inquiry

- A. Explain that there are not fixed procedures for guiding scientific investigations; however, the nature of an investigation determines the procedures needed. I-A
- B. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations. I-B, II-F, I
- C. Distinguish between observation and inference. I-E
- D. Explain that a single example can never prove that something is always correct, but sometimes a single example can disprove something. I-H, I, G, II-D
- E. *Use data to describe events and construct reasonable explanations. I-F*
- F. *Defend a scientific argument by logically demonstrating connections among natural phenomena, investigations, and historic body of scientific knowledge. I-J*

Benchmarks for Standard I: 6-8

- A. Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.**
- B. Analyze and interpret data from scientific investigations using appropriate mathematics skills in order to draw valid conclusions.**

Standard II, III: Inquiry, Unifying Concepts and Processes in Science, and Science in Personal and Social Perspectives

- A. *Observe, compare, and classify objects and organisms by common characteristics. II-A*
- B. *Sequence objects and make predictions about missing information. II-B*
- C. *Compare and contrast mass, dimension, and volume of familiar objects and organisms. II-E*
- D. *Select and use appropriate materials, measuring devices, and tools to conduct investigation. II-F*
- E. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- F. *Explore influences and interactions of objects/organisms. II-H*
- G. *Compare and contrast diverse structures and their associated functions. II-I*
- H. *Recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms, and systems. II-J*
- I. *Recognize the interrelationships of science and health in personal health issues. III-A*
- J. *Identify characteristics and changes in population. III-B*
- K. *Identify, define, and integrate natural resources. III-C*
- L. Explain how technology influences the quality of life. III-H
- M. Explain how decisions about the use of products and systems can result in desirable or undesirable consequences (e.g., social and environmental). III-H
- N. Describe how automation (e.g., robots) has changed manufacturing including manual labor being replaced by highly-skilled jobs. Soc. Stud. VI-F, III-G
- O. Explain how the usefulness of manufactured parts of an object depend on how well their properties allow them to fit and interact with other materials. Soc. Stud. VI-F, II-C
- P. Design and build a product or create a solution to a problem given one constraint (e.g., limits of cost and time for design and production, supply of materials and environmental effects). III-D, F
- Q. Identify that hypotheses are valuable even when they are not supported. I-F, II-D

- R. Describe why it is important to keep clear, thorough and accurate records. I-F, G, II-D
- S. Identify ways scientific thinking is helpful in a variety of everyday settings. I-A, E, F, G, III-G
- T. Describe how the pursuit of scientific knowledge is beneficial for any career and for daily life. III-G, E, F
- U. Research how men and women of all countries and cultures have contributed to the development of science. I-I, III-H

Benchmarks for Standards II, III: 6-8

- A. Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.**
- B. Design a solution or product taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety and aesthetics).**
- C. Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).**
- D. Explain the importance of reproducibility and reduction of bias in scientific methods.**
- E. Give examples of how thinking scientifically is helpful in daily life.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 7 – Science Standards

Standard I: Science as Inquiry

- A. Explain that variables and controls can affect the results of an investigation and that ideally one variable should be tested at a time; however it is not always possible to control all variables. I-B, II-D, H, LS-D
- B. Identify simple independent and dependent variables. I-B
- C. Formulate and identify questions to guide scientific investigations that connect to science concepts and can be answered through scientific investigations. I-C, J, II-D, A
- D. Choose the appropriate tools and instruments and use relevant safety procedures to complete scientific investigations. I-C
- E. Analyze alternative scientific explanations and predictions and recognize that there may be more than one good way to interpret a given set of data. I-H, F
- F. Identify faulty reasoning and statements that go beyond the evidence or misinterpret the evidence. I-H, G, I
- G. Use graphs, tables and charts to study physical phenomena and infer mathematical relationships between variables (e.g., speed and density). I-C, II-D, E

Benchmarks for Standard I: 6-8

- A. Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.**
- B. Analyze and interpret data from scientific investigations using appropriate mathematics skills in order to draw valid conclusions.**

Standard II, III: Inquiry, Unifying Concepts and Processes in

Science, and Science in Personal and Social Perspectives

- A. Show that the reproducibility of results is essential to reduce bias in scientific investigations. I-D, H, II-G
- B. Describe how repetition of an experiment may reduce bias. II-G, D
- C. Describe how the work of science requires a variety of human abilities and qualities that are helpful in daily life (e.g., reasoning, creativity, skepticism and openness). III-E, F, G, H, II-H, I, J
- D. Explain how needs, attitudes and values influence the direction of technological development in various cultures. III-H
- E. Describe how decisions to develop and use technologies often put environmental and economic concerns in direct competition with each other. III-D, E, F, G
- F. Recognize that science can only answer some questions and technology can only solve some human problems. III-H
- G. Design and build a product or create a solution to a problem given two constraints (e.g., limits of cost and time for design and production or supply of materials and environmental effects). III-D
- H. *Observe, compare, and classify objects and organisms by common characteristics. II-A*
- I. *Sequence objects and make predictions about missing information. II-B*
- J. *Compare and contrast mass, dimension, and volume of familiar objects and organisms. II-D*
- K. *Select and use appropriate materials, measuring devices and tools to conduct investigations. II-F*
- L. *Recognize the interrelationships of science and health in personal health issues. III-A*
- M. *Identify characteristics and changes in population. III-B*
- N. *Identify, define and integrate natural resources. III-C*

Benchmarks for Standards II, III: 6-8

- A. Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.**
- B. Design a solution or product taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety and aesthetics).**
- C. Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).**
- D. Explain the importance of reproducibility and reduction of bias in scientific methods.**
- E. Give examples of how thinking scientifically is helpful in daily life.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 8 – Science Standards

Standard I: Science as Inquiry

- A. *Ask questions that can be answered through scientific investigation. I-A*
- B. *Recognize and analyze alternative explanations, predictions, and models using critical thinking and logical analysis. I-1*
- C. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations. II-F
- D. Describe the concepts of sample size and control and explain how these affect scientific investigations. I-B,J, II-D
- E. Read, construct and interpret data in various forms produced by self and others in both written and oral form (e.g., tables, charts, maps, graphs, diagrams and symbols). I-D, F, G, H
- F. Apply appropriate math skills to interpret quantitative data (e.g., mean, median and mode). I-D

Benchmarks for Standard I: 6-8

- A. Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.**
- B. Analyze and interpret data from scientific investigations using appropriate mathematics skills in order to draw valid conclusions.**

Standard II, III: Inquiry, Unifying Concepts and Processes in Science, and Science in Personal and Social Perspectives

- A. *Demonstrate an understanding of the interrelatedness of system using visual representations. II-C*
- B. *Compare and contrast mass, dimension, and volume of familiar objects and organisms. II-E*
- C. *Select and use appropriate materials, measuring devices and tools to conduct investigations. II-F*
- D. *Compare and contrast diverse structures and their associated functions. II-I*
- E. *Recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms, and systems. II-J*
- F. *Identify characteristics and changes in population. III-B*
- G. *Identify, define and integrate natural resources. III-C*
- H. *Explore environmental changes and their consequences. III-D*
- I. Identify the difference between description (e.g., observation and summary) and explanation (e.g., inference, prediction, significance an importance). I-E, F, G, H, II-A, B
- J. Explain why it is important to examine data objectively and not let bias affect observations. I-D, H, II-G, D
- K. Examine how science and technology have advanced through the contributions of many different people, cultures and times in history. I-1, III-G, I-B, II-D
- L. Examine how choices regarding the use of technology are influenced by constraints caused by various unavoidable factors (e.g., geographic location, limited resources, social, political and economic considerations). I-H, I, III-J
- M. Design and build a product or create a solution to a problem given more than two constraints (e.g., limits of cost and time for design and production, supply of materials and environmental effects). III-E, F, H; II-H
- N. Evaluate the overall effectiveness of a product design or solution. I-F, III-A

Benchmarks for Standards II, III: 6-8

- A. Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.**
- B. Design a solution or product taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety and aesthetics).**
- C. Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).**
- D. Explain the importance of reproducibility and reduction of bias in scientific methods.**
- E. Give examples of how thinking scientifically is helpful in daily life.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 9 – Science Standards

Standard I: Science as Inquiry

- A. Distinguish between observations and inferences given a scientific situation. II-D, I-A
- B. Research and apply appropriate safety precautions when designing and conducting scientific investigations) e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). I-B, II-A
- C. Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts. I-F, G
- D. Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. I-C, D
- E. Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. I-G, C, D,
- F. Draw logical conclusions based on scientific knowledge and evidence from investigations. I-F, I, II-D
- G. *Use technology and math to improve investigations and communications. I-E*

Benchmarks for Standard I: 9-10

- A. Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.**

Standard II, III: Inquiry, Unifying Concepts and Processes in Science, and Science in Personal and Social Perspectives

- A. *Compare and contrast mass, dimension and volume of familiar objects and organisms. II-E*

- B. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- C. *Compare and contrast diverse structures and their associated functions. II-I*
- D. *Identify characteristics and changes in population. III-B*
- E. *Identify, define, and integrate natural resources. III-C*
- F. *Explore environmental changes and their consequences. III-D*
- G. *Develop an awareness of life and career opportunities in science and technology. III-G*
- H. Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. I-I, III-H
- I. Illustrate that the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. I-F, EVS-A-I, B-A-I, II-B
- J. Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. I-H
- K. Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. I-H, III-F
- L. Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. I-I
- M. Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data. I-E, F, H
- N. Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. I-H, I
- O. Illustrate that much can be learned about the internal working of science and the nature of science from the study of scientists, their daily work and their efforts to advance scientific knowledge in their area of study. I-H, I
- P. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. III-G
- Q. Describe means of comparing the benefits with the risks of technology and how science can inform public policy. I-C, D, H, III-F, A, C, IS-SA
- R. Identify a problem or need, propose designs and choose among alternative solutions for the problem. II-C, IS-A-2
- S. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. II-J

Benchmarks for Standards II, III: 9-10

- A. Explain the ways in which the processes of technological design respond to the needs of society.**
- B. Explain that science and technology are interdependent; each drives the other.**
- C. Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.**
- D. Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.**
- E. Describe the ethical practices and guidelines in which science operates.**
- F. Recognize that scientific literacy is part of being a knowledgeable citizen.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Grade 10 – Science Standards

Standard I: Science as Inquiry

- A. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g. OSHA, MSDS, eyewash, goggles and ventilation). III-A, B, C
- B. Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps and available technology. I-C, D, G,
- C. Use mathematical models to predict and analyze natural phenomena. I-D
- D. Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. I-F
- E. Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected. I-H, II-D
- F. *Ask questions that can be answered through scientific investigations. I-A*

Benchmarks for Standard I: 9-10

- A. Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.**

Standard II, III: Inquiry, Unifying Concepts and Processes in Science, and Science in Personal and Social Perspectives

- A. *Observe, compare and classify objects and organisms by common characteristics. II-A*
- B. *Demonstrate an understanding of the interrelatedness of systems using visual representations. II-D*
- C. *Select and use appropriate materials, measuring devices, and tools to conduct investigation. II-F*

- D. *Recognize that some characteristics and properties remain constant while others change in varying trends and cycles. II-G*
- E. *Compare and contrast diverse structures and their associated functions. II-I*
- F. *Recognize that evolution is change over time and that it accounts for the present form and functions of objects, organisms, and systems. II-J*
- G. *Identify characteristics and changes in population. III-B*
- H. *Explore environmental changes and their consequences. III-D*
- I. Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. III-G, I-I
- J. Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree the questioning, response to criticism and open communication are integral to the process of science. I-G, H, I, III-H
- K. Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to more adequate explanations of natural phenomena. I-E, F, II-D
- L. Recognize that ethical considerations limit what scientists can do. II-F, BA2, EVSA9
- M. Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws. III-F, BA2, EVSA9
- N. Recognize that animal-based research must be conducted according to currently accepted professional standards and laws. III-F, BA2, EVSA9
- O. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue. III-G
- P. Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need

- to meet human needs and solve human problems. II-H, D, III-E, A
- Q. Describe examples of scientific advances and emerging technologies and how they may impact society. III-G, H, F, C; ES-A-6; B, B-12
- R. Explain that when evaluating a design for a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced and disposed of in addition to who will sell, operate and take care of it. Explain how the costs associated with these considerations may introduce additional constraints on the design. II-B, E, III-G, H

Benchmarks for Standards II, III: 9-10

- A. Explain the ways in which the processes of technological design respond to the needs of society.**
- B. Explain that science and technology are interdependent; each drives the other.**
- C. Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.**
- D. Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.**
- E. Describe the ethical practices and guidelines in which science operates.**
- F. Recognize that scientific literacy is part of being a knowledgeable citizen.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- Items in italics reference the Diocesan COS objectives that are not in state standards.

- Bolded statements after each standard are state benchmarks for the grade span.

Content Standard IV: Life Science K-2

Organizers	Kindergarten	First Grade	Second Grade
<p><i>Characteristics and Structure of Life</i></p>	<p>Explore differences between living and non-living things (e.g., plant – rock). IV-A</p> <p>Discover that stories (e.g., cartoons, movies, comics) sometimes give plants and animals characteristics they really do not have (e.g., talking flowers). IV-A</p>	<p>Explore that organisms, including people, have basic needs which include air, water, food, living space and shelter. IV-A, H</p> <p>Explain that food comes from sources other than grocery stores (e.g. farm crops, farm animals, oceans, lakes and forests). IV-H</p> <p>Explore that humans and other animals have body parts that help to seek, find and take in food when they are hungry (e.g., sharp teeth, flat teeth, good nose, sharp vision). IV-F</p>	<p>Explain that animals, including people, need air, water, food, living space and shelter, and plants need air, water, nutrients (e.g., minerals), living space and light to survive. IV-A, III-A</p> <p>Identify that there are many distinct environments that support different kinds of organisms. IV-H</p> <p>Explain why organisms can survive only in environments that meet their needs (e.g., organisms that once lived on Earth have disappeared for different reasons such as natural forces or human-caused effects). III-D, IV-H, D</p>
<p><i>Heredity</i></p>	<p>Describe how plants and animals usually resemble their parents. IVG</p> <p>Investigate variations that exist among individuals of the same kind of plant or animal. IV-A, IIA</p>		<p>Compare similarities and differences among individuals of the same kind of plants and animals, including people. IV-A, G, II-A</p>
<p><i>Diversity and Interdependence of Life</i></p>	<p>Investigate observable features of plants and animals that help them live in different kinds of places. IV-A</p> <p>Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community. IV-H</p>	<p>Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting. IV-H</p> <p>Recognize that seasonal changes can influence the health, survival or activities of organisms. II-H</p>	<p>Explain that food is a basic need of plants and animals (e.g., plants need sunlight to make food and to grow, animals eat plants and/or other animals for food, food chain) and is important because it is a source of energy (e.g., energy used to play, ride bicycles, read, etc.). II-H</p> <p>Investigate the different structures of plants and animals that help them live in different environments (e.g., lungs, gills, leaves and roots). IV-A</p>

<p><i>Diversity and Interdependence of Life</i></p>			<p>Compare the habitats of many different kinds of Ohio plants and animals and some of the ways animals depend on plants and each other. IV-H</p> <p>Compare the activities of Ohio's common animals (e.g., squirrels, chipmunks, deer, butterflies, bees, ants, bats and frogs) during the different seasons by describing changes in their behaviors and body covering. IV-A, D, H</p> <p>Compare Ohio plants during the different seasons by describing changes in their appearance. IV-D</p>

Benchmarks for Standard IV: K-2

- A. Discover that there are living things, non-living things and pretend things, and describe the basic needs of living things (organisms).**
- B. Explain how organisms function and interact with their physical environment.**
- C. Describe similarities and differences that exist among individuals of the same kind of plants and animals.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard IV: Life Science 3-5

Organizers	Third Grade	Fourth Grade	Fifth Grade
<i>Heredity</i>	Compare the life cycles of different animals including birth to adulthood, reproduction and death (e.g., egg-tadpole-frog, egg-caterpillar-chrysalis-butterfly). IV-E	Compare the life cycles of different plants including germination, maturity, reproduction and death. IV-E	
<i>Diversity and Interdependence of Life</i>	<p>Relate animal structures to their specific survival functions (e.g., obtaining food, escaping or hiding from enemies). IV-C</p> <p>Classify animals according to their characteristics (e.g., body coverings and body structure). IV-C, F</p> <p>Use examples to explain that extinct organisms may resemble organisms that are alive today. IV-G, F</p> <p>Observe and explore how fossils provide evidence about animals that lived long ago and the nature of the environment at that time. II-A, B</p> <p>Describe how changes in an organism's habitat are sometimes beneficial and sometimes harmful. III-D, IV-D</p>	<p>Relate plant structures to their specific functions (e.g., growth, survival and reproduction). IV-B, C</p> <p>Classify common plants according to their characteristics (e.g., tree leaves, flowers, seeds, roots, stems). IV-A, II-A</p> <p>Observe and explore that fossils provide evidence about plants that lived long ago and the nature of the environment at that time. II-A, B</p> <p>Describe how organisms interact with one another in various ways (e.g., many plants depend on animals for carrying pollen or dispersing seeds). IV-H, II-H</p>	<p>Describe the role of producers in the transfer of energy entering ecosystems as sunlight to chemical energy through photosynthesis. IV-H, V-H</p> <p>Explain how almost all kinds of animals' food can be tracked back to plants. IV-H</p> <p>Trace the organization of simple food chains and food webs (e.g., producers, herbivores, carnivores, omnivores and decomposers). IV-H, II-H</p> <p>Summarize that organisms can survive only in ecosystems in which their needs can be met (e.g., food, water, shelter, air, carrying capacity and waste disposal). the world has different ecosystems and distinct ecosystems support the lives of different types of organisms. IV-H, II-H</p>

		<p>Support how an organism's patterns of behavior are related to the nature of that organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem. IV-H, II-H, D</p> <p>Analyze how all organisms, including humans, cause changes in their ecosystems and how these changes can be beneficial, neutral or detrimental (e.g., beaver ponds, earthworm burrows, grasshoppers eating plants, people planting and cutting trees, and people introducing a new species. IV-H</p>
--	--	---

Benchmarks for Standard IV: 3-5

- A. Differentiate between the life cycles of different plants and animals.**
- B. Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system that all organisms use to survive.**
- C. Compare changes in an organism's ecosystem/habitat that affect its survival.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard IV: Life Science 6-8

Organizers	Sixth Grade	Seventh Grade	Eighth Grade
<p><i>Characteristics and Structure of Life</i></p>	<p>Explain that many of the basic functions or organisms are carried out by or within cells and are similar in all organisms. IV-B, C</p> <p>Explain that multicellular organisms have a variety of specialized cells, tissues, organs and organ systems that perform specialized functions. IV-B, C</p> <p>Identify how plant cells differ from animal cells (e.g., cell wall and chloroplasts). IV-A</p>	<p>Investigate the great variety of body plans and internal structures found in multicellular organisms. IV-A, B, C</p>	
<p><i>Heredity</i></p>	<p>Recognize that an individual organism does not live forever; therefore reproduction is necessary for the continuation of every species and traits are passed on to the next generation through reproduction. LS IV-E, F, G</p> <p>Describe that in asexual reproduction all the inherited traits come from a single parent. IV-E, F, G</p> <p>Describe that in sexual reproduction an egg and sperm unite and some traits come from each parent, so the offspring is never identical to either of its parents. IV- E, F, G</p> <p>Recognize that likenesses between parents and offspring (e.g., eye color, flower color) are inherited. Other likenesses, such as table manners are learned. IV-E, F, G</p>		<p>Describe that asexual reproduction limits the spread of detrimental characteristics through a species and allows for genetic continuity. IV-E</p> <p>Recognize that in sexual reproduction new combinations of traits are produced which may increase or decrease an organism's chances for survival. IV-E, G</p>

<p><i>Diversity and Interdependence of Life</i></p>	<p>Describe how organisms may interact with one another. IV-A, D, H</p>	<p>Investigate how organisms or populations may interact with one another through symbiotic relationships and how some species have become so adapted to each other that neither could survive without the other (e.g., predator-prey, parasitism, mutualism and commensalism). IV-D, H</p> <p>Explain how the number of organisms an ecosystem can support depends on adequate biotic (living) resources (e.g., plants, animals) and abiotic (non-living) resources (e.g., light, water and soil). IV-D, H, I</p> <p>Investigate how overpopulation impacts an ecosystem. IV-H, I</p> <p>Explain that some environmental changes occur slowly while others occur rapidly (e.g. forest and pond succession, fires and decomposition). IV-H, I</p> <p>Summarize the ways that natural occurrences and human activity affect the transfer of energy in Earth's ecosystems (e.g., fire, hurricanes, roads and oil spills). IV-A</p> <p>Explain that photosynthetic cells convert solar energy into chemical energy that is used to carry on life functions or is transferred to consumers and used to carry on their life functions. IV-I</p>	
<p><i>Evolutionary Theory</i></p>		<p>Investigate the great diversity among organisms. IV-E, F, G</p>	<p>Explain how variations in structure, behavior or physiology allow some organisms to enhance their reproductive success and survival in a particular environment. IV-E, F, G</p>

			<p>Explain that diversity of species is developed through gradual processes over many generations (e.g., fossil record).</p> <p>Investigate how an organism adapted to a particular environment may become extinct if the environment, as shown by the fossil record, changes. I-I, II-J</p>
--	--	--	--

Benchmarks for Standard IV: 6-8

A. Explain that the basic functions of organisms are carried out in cells and groups of specialized cells form tissues and organs; the combination of these cells make up multicellular organisms that have a variety of body plans and internal structures.

B. Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as a characteristic of living organisms essential to the continuation of the species.

C. Explain how energy entering the ecosystems as sunlight supports the life of organisms through photosynthesis and the transfer of energy through the interactions of organisms and the environment.

D. Explain how extinction of a species occurs when the environment changes and its adaptive characteristics are insufficient to allow survival (as seen in evidence of the fossil record).

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- Bolded statements after each standard are state benchmarks for the grade span.

Content Standard IV: Life Science 9-10

Organizers	Ninth Grade	Tenth Grade
<p><i>Characteristics and Structure of Life</i></p>	<p>No Indicators present in this grade for Life Science</p>	<p>Explain that living cells</p> <ul style="list-style-type: none"> a) are composed of a small number of key chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur) IV-C b) are the basic unit of structure and function of all living things IV-C c) come from pre-existing cells after life originated, and IV-B d) are different from viruses IV-A <p>Compare the structure, function and interrelatedness of cell organelles in eukaryotic cells (e.g., nucleus, chromosome, mitochondria, cell membrane, cell wall, chloroplast, cilia, flagella) and prokaryotic cells. IV-C</p> <p>Explain the characteristics of life as indicated by cellular processes including</p> <ul style="list-style-type: none"> a) homeostasis b) energy transfers and transformation c) transportation of molecules d) disposal of wastes e) synthesis of new molecules IV-C <p>Summarize the general processes of cell division and differentiation, and explain why specialized cells are useful to organisms and explain that complex multicellular organisms are formed as highly organized arrangements of differentiated cells. IV-C</p>
<p><i>Heredity</i></p>		<p>Illustrate the relationship of the structure and function of DNA to protein synthesis and the characteristics of an organism. IV-G</p> <p>Explain that a unit of hereditary information is called a gene, and genes may occur in different forms called alleles (e.g., gene for pea plant height has two alleles, tall and short). IV-G</p> <p>Describe that spontaneous changes in DNA are mutations, which are a source of genetic variation. When mutations occur in sex cells, they may be passed on to future generations; mutations that occur in body cells may affect the functioning of that cell or the organism in which that cell is found. IV-G, D</p> <p>Use the concepts of Mendelian and non-Mendelian genetics (e.g., segregation, independent assortment, dominant and recessive traits, sex-linked traits and jumping genes) to explain inheritance. IV-G</p>

<p><i>Diversity and Interdependence of Life</i></p>		<p>Describe how matter cycles and energy flows through different levels of organization in living systems and between living systems and the physical environment. Explain how some energy is stored and much is dissipated into the environment as thermal energy (e.g., food webs and energy pyramids). IV-I</p> <p>Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation). IV-C</p> <p>Explain that living organisms use matter and energy to synthesize a variety of organic molecules (e.g., proteins, carbohydrates, lipids and nucleic acids) and to drive life processes (e.g., growth, reacting to the environment, reproduction and movement). IV-I, D</p> <p>Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system. Relate how biologists arrange organisms into a hierarchy of groups and subgroups based on similarities and differences that reflect their evolutionary relationships. IV-A</p> <p>Explain that the variation of organisms within a species increases the likelihood that at least some members of a species will survive under gradually changing environmental conditions. IV-G</p> <p>Relate diversity and adaptation to structures and their functions in living organisms (e.g., adaptive radiation). IV-G</p> <p>Explain how living things interact with biotic and abiotic components of the environment (e.g., predation, competition, natural disasters and weather). IV-H</p> <p>Relate how distribution and abundance of organisms and populations in ecosystems are limited by the ability of the ecosystem to recycle materials and the availability of matter, space and energy. IV-H</p> <p>Conclude that ecosystems tend to have cyclic fluctuations around a state of approximate equilibrium that can change when climate changes, when one or more new species appear as a result of immigration or when one or more species disappear. IV-H</p> <p>Describe ways that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. Explain how changes in technology/biotechnology can cause significant changes, either positive or negative, in environmental quality and carrying capacity. IV-H</p> <p>Illustrate how uses of resources at local, state, regional, national, and global levels have affected the quality of life (e.g., energy production and sustainable vs. nonsustainable agriculture). IV-I</p>
<p><i>Evolutionary Theory</i></p>		<p>Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution. IV-G</p> <p>Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species. These characteristics may give individuals an advantage or disadvantage compared to others in surviving and reproducing. The advantaged offspring are more likely to survive and reproduce. Therefore, the proportion of individuals that have advantageous characteristics will increase. When an environment changes, the survival value of some inherited characteristics may change. IV-E, F, G, II-J</p>

<i>Evolutionary Theory</i>		<p>Describe historical scientific developments that occurred in evolutionary thought (e.g., Lamarck and Darwin, Mendelian Genetics and modern synthesis). II-J</p> <p>Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this indicator does not mandate the teaching or testing of intelligent design.) II-J</p> <p>Analyze how natural selection and other evolutionary mechanisms (e.g., genetic drift, immigration, emigration, mutation) and their consequences provide a scientific explanation for the diversity and unity of past life forms, as depicted in the fossil record, and present life forms. II-J</p> <p>Explain that life on Earth is thought to have begun as simple, one celled organisms approximately 4 billion years ago. During most of the history of Earth only single celled microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved. II-J</p>
<i>Historical Perspectives and Scientific Revolutions</i>		<p>Use historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., biological evolution, germ theory, biotechnology and discovering germs). II-J</p> <p>Describe advances in life sciences that have important long-lasting effects on science and society (e.g., biological evolution, germ theory, biotechnology and discovering germs). II-J</p> <p>Analyze and investigate emerging scientific issues (e.g., genetically modified food, stem cell research, genetic research and cloning). II-J</p>

Benchmarks for Standard IV: 9-10

- A. Explain that cells are the basic unit of structure and function of living organisms, that once life originated all cells come from pre-existing cells, and that there are a variety of cell types.**
- B. Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development.**
- C. Explain the genetic mechanisms and molecular basis of inheritance.**
- D. Explain the flow of energy and the cycling of matter through biological and ecological systems (cellular, organismal and ecological).**
- E. Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life.**
- F. Explain the structure and function of ecosystems and relate how ecosystems change over time.**
- G. Describe how human activities can impact the status of natural systems.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

H. Describe a foundation of biological evolution as the change in gene frequency of a population over time. Explain the historical and current scientific developments, mechanisms and processes of biological evolution. Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this benchmark does not mandate the teaching or testing of intelligent design.)

I. Explain how natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms.

J. Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences.

Content Standard VI: Physical Science K-2

Organizers	Kindergarten	First Grade	Second Grade
<i>Nature of Matter</i>	<p>Demonstrate that objects are made of parts (e.g., toys, chairs). III-A, VI-C</p> <p>Examine and describe objects according to the material that make up the object (e.g., wood, metal, plastic, cloth). VI-A</p> <p>Describe and sort objects by one or more properties (e.g., size, color, shape). VI-A</p>	<p>Classify objects according to the materials they are made of and their physical properties. VI-A</p> <p>Investigate that water can change from liquid to solid or solid to liquid. VI-D</p> <p>Explore and observe that things can be done to materials to change their properties (e.g., heating freezing, mixing, cutting, wetting, dissolving, bending, exposing to light). VI-D</p> <p>Explore changes that greatly change the properties of an object (e.g., burning paper) and changes that leave the properties largely unchanged (e.g., tearing paper). VI-B</p>	
<i>Forces and Motion</i>	<p>Explore that things can be made to move in many different ways such as straight, zigzag, up and down, round and round, back and forth, or fast and slow. VI-G</p> <p>Investigate ways to change how something is moving (e.g., push, pull). VI-G</p>	<p>Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets). VI-I</p> <p>Investigate a variety of ways to make things move and what causes them to change speed, direction and/or stop. VI-G, VI-H</p>	<p>Explore how things make sound (e.g., rubber bands, tuning fork, strings). VI-I</p> <p>Explore and describe sounds (e.g., high, low, soft, loud) produced by vibrating objects. VI-I</p> <p>Explore with flashlights and shadows that light travels in a straight line until it strikes an object. VI-I</p>

<i>Nature of Energy</i>		<p>Explore how energy makes things work (e.g., batteries in a toy, electricity turning fan blades). VI-B, H, G</p> <p>Recognize that the sun is an energy source that warms the land, air and water. VI-I</p> <p>Describe that energy can be obtained from many sources in many ways (e.g., food, gasoline, electricity or batteries). VI-I, B, G</p>	
-------------------------	--	---	--

Benchmarks for Standard VI: K-2

- A. Discover that many objects are made of parts that have different characteristics. Describe these characteristics and recognize ways an object may change.**
- B. Recognize that light, sound and objects move in different ways.**
- C. Recognize sources of energy and their uses.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard VI: Physical Science 3-5

Organizers	Third Grade	Fourth Grade	Fifth Grade
<i>Nature of Matter</i>		<p>Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible). VI-A, D</p> <p>Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different from the original materials (e.g., burning paper, vinegar and baking soda). VI-B, E, F</p> <p>Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic, metal). VI-A, C, II-A</p> <p>Explain that matter has different states (e.g., solid, liquid and gas) and that each state has distinct physical properties. VI-D</p>	
<i>Forces and Motion</i>	<p>Describe an objects position by locating it relative to another object or the background. VI-G</p> <p>Describe an objects motion by tracing and measuring its position over time. VI-G</p> <p>Identify contact/noncontact forces that affect motion of an object (e.g., gravity, magnetism, collision). VI-I</p> <p>Predict the changes when an object experiences a force (e.g., a push or pull, weight, friction). VI-G</p>		

<i>Nature of Energy</i>		Compare ways the temperature of an object can be changed (e.g., rubbing, heating, bending of metal). VI-I	<p>Define temperature as the measure of thermal energy and describe the way it is measured. VI-I, H</p> <p>Trace how thermal energy can transfer from one object to another by conduction. VI-I, H</p> <p>Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces. VI-I, H</p> <p>Trace how electrical current travels by creating a simple electric circuit that will light a bulb. VI-I, H</p> <p>Explore and summarize observations of the transmission, bending (refraction) and reflection of light. VI-I, H</p> <p>Describe and summarize observations of the transmission, reflection, and absorption of sound. VI-I, H</p> <p>Describe that changing the rate of vibration can vary the pitch of a sound. VI-I, H</p>
-------------------------	--	---	---

Benchmarks for Standard VI: 3-5

- A. Compare the characteristics of simple physical and chemical changes.**
- B. Identify and describe the physical properties of matter in its various states.**
- C. Describe the forces that directly affect objects and their motion.**
- D. Summarize the way changes in temperature can be produced and thermal energy transferred.**
- E. Trace how electrical energy flows through a simple electrical circuit and describe how the electrical energy can produce thermal energy, light, sound and magnetic forces.**
- F. Describe the properties of light and sound energy.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard VI: Physical Science 6-8

Organizers	Sixth Grade	Seventh Grade	Eighth Grade
<i>Nature of Matter</i>	<p>Explain that equal volumes of different substances usually have different masses. VI-E, Chem BCO#2, VI-A, D, F, C</p> <p>Describe that in a chemical change new substances are formed with different properties than the original substance (e.g., rusting, burning). VI-D, F, E, B, IS 2 C, BCO 32</p> <p>Describe that in a physical change (e.g., state, shape and size) the chemical properties of substance remain unchanged. VI-D, F, C</p> <p>Describe that chemical and physical changes occur all around us (e.g., in the human body, cooking and industry). VI-G, III-D, IS 2C</p>	<p>Investigate how matter can change forms but the total amount of matter remains constant. VI-A, I</p>	
<i>Forces and Motion</i>			<p>Describe how the change in the position (motion) of an object is always judged and described in comparison to a reference point. VI-G</p> <p>Explain that motion describes the change in the position of an object (characterized by a speed and direction) as time changes. VI-G</p> <p>Explain that an unbalanced force acting on an object changes that object's speed and/or direction. VI-G</p>

<p><i>Nature of Energy</i></p>	<p>Explain that the energy found in nonrenewable resources such as fossil fuels (e.g., oil, coal and natural gas) originally came from the sun and may renew slowly over millions of years. III-C, E, SS, H, V-L, EVS-II, 14, 20, 22</p> <p>Explain that energy derived from renewable resources such as wind and water is assumed to be available indefinitely. III-E, V-H, L, EVS-20-22</p> <p>Describe how renewable and nonrenewable energy resources can be managed (e.g., fossil fuels, trees and water). EVS-10, 11</p>	<p>Describe how an object can have potential energy due to its position or chemical composition and can have kinetic energy due to its motion. VI-6</p> <p>Identify different forms of energy (e.g., electrical, mechanical, chemical, thermal, nuclear, radiant and acoustic). VI-H</p> <p>Explain how energy can change forms but the total amount of energy remains constant. VI-I</p> <p>Trace energy transformation in a simple closed system (e.g., a flashlight). VI-I</p>	<p>Demonstrate that waves transfer energy. VI-I</p> <p>Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves). V-A, B, VI-I</p>
--------------------------------	--	---	---

Benchmarks for Standard VI: 6-8

A. Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.

B. In simple cases, describe the motion of objects and conceptually describe the effects of forces on an object.

C. Describe renewable and nonrenewable sources of energy (e.g., solar, wind, fossil fuels, biomass, hydroelectricity, geothermal and nuclear energy) and the management of these sources.

D. Describe that energy takes many forms, some forms represent kinetic energy and some forms represent potential energy; and during energy transformations the total amount of energy remains constant.

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard VI: Physical Science 9-10

Organizers	Ninth Grade	Tenth Grade
<p><i>Nature of Matter</i></p>	<p>Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. VI-F, I-S, 2E, 2L, 2F, BCO-5, 8</p> <p>Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. BCO-5, VI-F, 2E, 2F</p> <p>Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. ACO-7, 1, VI-I, BCO-7, 5, 6</p> <p>Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations. VI-F, IS-2i, BCO-13, 14, 8</p> <p>Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons. VI-F, IS, 2h</p> <p>Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). VI-F, BCO-21, 5, 6, 8, 16</p> <p>Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). IS-2h, PS-E, BCO-10, 11, 15, 17, 19, 33, 34</p> <p>Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. IS-B2j, B2-K, BCO-28, AO-9, VI-B</p> <p>Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors). VI-B, C, IS-B2d</p> <p>Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity. VI-F, IS-J</p>	<p>No indicators present in this grade for Physical Sciences standard.</p>

<p><i>Nature of Energy</i></p>	<p>Explain how thermal energy exists in the random motion and vibrations of atoms and Molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. IS-H, I, BCO-26, 22, 23, P-6</p> <p>Explain how an object's kinetic energy depends on its mass and its speed ($KE = \frac{1}{2}mv^2$). P-4</p> <p>Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight (mg where m is the object's mass and g is the acceleration due to gravity) and height (h) above a reference surface ($PE = mgh$). P-4, IS-H-D, D-7</p> <p>Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies.) ACO-2, P-12, VI-I-4</p> <p>Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy. PS-G, H, EVS-14, IS-4f, BCO-4</p> <p>Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). BCO-26</p> <p>Demonstrate that thermal energy can be transferred by conduction, convection or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). P-6, IS, 4-I</p> <p>Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). VI-I, IS-4k, j, P-11, 16</p> <p>Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium. VI-I, IS-4k, P-11, 16</p> <p>Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed by materials they enter, and change direction and speed when entering a different material. VI-I, IS-4k</p>	
--------------------------------	--	--

<p><i>Forces and Motion</i></p>	<p>Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time. VI-G, IS-4a, b, P-1, 2, 4</p> <p>Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it. VI-6, IS-4c, P-3</p> <p>Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object. ($F_{net} = ma$. Note that weight is the gravitational force on a mass.) IS-4c, P-3, VI-G</p> <p>Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object. IS-4c, P-3, VI-G</p> <p>Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight). IS-4b, c, VI-G, P-2, 3</p>	
<p><i>Historical Perspectives and Scientific Revolutions</i></p>	<p>Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., atomic theory, quantum theory and Newtonian mechanics). I-H, IS-5h</p> <p>Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology). I-H, I, IS-5h</p>	

Benchmarks for Standard VI: 9-10

- A. Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.**
- B. Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.**
- C. Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.**
- D. Explain the movement of objects by applying Newton's three laws of motion.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

- E. Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).**
- F. Explain how energy may change form or be redistributed but the total quantity of energy is conserved.**
- G. Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.**
- H. Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.**

Content Standard V: Earth and Space Sciences K-2

Organizers	Kindergarten	First Grade	Second Grade
<p><i>The Universe</i></p>	<p>Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day. V-H</p>		<p>Recognize that there are more stars in the sky than anyone can easily count. V-I</p> <p>Observe and describe how the sun, moon and stars all appear to move slowly across the sky. V-I</p> <p>Observe and describe how the moon appears a little different every day but looks nearly the same again about every four weeks. V-I</p> <p><i>Investigate the development of the space program and space exploration. V-K</i></p>
<p><i>Processes That Shape Earth</i></p>	<p>Explore that animals and plants cause changes to their surroundings. IV-H</p> <p>Explore that sometimes change is too fast to see and sometimes change is too slow to see. VI-D, V-B</p> <p>Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain). V-G</p> <p>Observe and describe seasonal changes in weather. V-G</p> <p><i>Identify and describe different types of materials in the lithosphere. V-A</i></p>	<p>Explain that all organisms cause changes in the environment where they live; the changes can be very noticeable or slightly noticeable, fast or slow (e.g., spread of grass cover slowing soil erosion, tree roots slowly breaking sidewalks). VI-D, V-B</p> <p><i>Identify and describe different types of materials in the lithosphere. V-A</i></p>	

<i>Earth Systems</i>		<p>Identify that resources are things that we get from the living (e.g., forests) and nonliving (e.g., minerals, water environment) and that resources are necessary to meet the needs and wants of a population. IV-C, V-C, L, M</p> <p>Explain that the supply of many resources is limited but the supply can be extended through careful use, decreased use, reusing and/or recycling. II-L, C, M, III-C, D, F</p>	<p>Observe and describe that some weather changes occur throughout the day and some changes occur in a repeating seasonal pattern. V-G, E</p> <p>Describe weather by measurable quantities such as temperature and precipitation. V-G, I-C, E, G</p>
----------------------	--	--	--

Benchmarks for Standard V: K-2

- A. Observe constant and changing patterns of objects in the day and night sky.**
- B. Explain that living things cause changes on Earth.**
- C. Observe, describe and measure changes in the weather, both long term and short term.**
- D. Describe what resources are and recognize some are limited but can be extended through recycling or decreased use.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard V: Earth and Space Sciences 3-5

Organizers	Third Grade	Fourth Grade	Fifth Grade
<i>The Universe</i>			<p>Describe how night and day are caused by Earth's rotation. V-I</p> <p>Explain that Earth is one of several planets to orbit the sun, and that the moon orbits Earth. V-I, J</p> <p>Describe the characteristics of Earth and its orbit about the sun (e.g., three-fourths of Earth's surface is covered by a layer of water [some of it frozen], the entire planet surrounded by a thin blanket of air, elliptical orbit, tilted axis and spherical planet). V-I</p> <p>Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light. V-I</p> <p><i>Investigate the development of the space program and space exploration. V-K</i></p>
<i>Processes That Shape Earth</i>		<p>Describe how wind, water and ice shape and reshape Earth's land surface by eroding rock and soil in some areas and depositing them in other areas producing characteristic landforms (e.g., dunes, deltas and glacial moraines). V-J, B, II-G</p> <p>Identify and describe how freezing, thawing and plant growth reshape the land surface by causing the weathering of rock. V-D, B, J, C, H</p>	

		Describe evidence of changes on Earth's surface in terms of slow processes (e.g., erosion, weathering, mountain building and deposition) and rapid processes (e.g. volcanic eruptions, earthquakes and landslides). V-B, F, D	
<i>Earth Systems</i>	<p>Compare distinct properties of rocks (e.g., color, layering and texture). V-A, B, II-A</p> <p>Observe and investigate that rocks are often found in layers. V-A, B, I-C, II-F</p> <p>Describe that smaller rocks come from the breakdown of larger rocks through the actions of plants and weather. V-A, B</p> <p>Observe and describe the composition of soil (e.g., small pieces of rock and decomposed pieces of plants and animals, and products of plants and animals). V-A, B</p> <p>Investigate the properties of soil (e.g., color, texture, capacity to retain water, ability to support plant growth). V-A, B</p> <p>Investigate that soils are often found in layers and can be different from place to place. V-A, B, II-F</p>	<p>Explain that air surrounds us, takes up space, moves around us as wind, and may be measured using barometric pressure. V-A, I-C, VI-H</p> <p>Identify how water exists in the air in different forms (e.g., in clouds, fog, rain, snow and hail). V-D, C</p> <p>Investigate how water changes from one state to another (e.g., freezing, melting, condensation and evaporation). V-E</p> <p>Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure. V-G, I-C</p> <p>Record local weather information on a calendar or map and describe changes over a period of time (e.g., barometric pressure, temperature, precipitation symbols and cloud conditions). I-B, C, E, G, V-G, H</p> <p>Trace how weather patterns generally move from west to east in the United States. V-G, I-C</p>	<p>Explain how the supply of many non-renewable resources is limited and can be extended through reducing, reusing and recycling but cannot be extended indefinitely. V-L</p> <p>Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained. V-L, M</p>

		Describe the weather which accompanies cumulus, cumulonimbus, cirrus and stratus clouds. V-G	
--	--	--	--

Benchmarks for Standard V: 3-5

- A. Explain the characteristics, cycles and patterns involving Earth and its place in the solar system.**
- B. Summarize the processes that shape Earth's surface and describe evidence of those processes.**
- C. Describe Earth's resources including rocks, soil, water, air, animals and plants and the ways in which they can be conserved.**
- D. Analyze weather and changes that occur over a period of time.**

Key to using this document:

- **Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- **Bolded statements after each standard are state benchmarks for the grade span.**

Content Standard V: Earth and Space Sciences 6-8

Organizers	Sixth Grade	Seventh Grade	Eighth Grade
<i>The Universe</i>			<p>Describe how objects in the solar system are in regular and predictable motions that explain such phenomena as days, years, seasons, eclipses, tides and moon cycles. I-J</p> <p>Explain that gravitational force is the dominant force determining motions in the solar system and in particular keeps the planets in orbit around the sun. V-J, I, II-H</p> <p>Compare the orbits and composition of comets and asteroids with that of Earth. V-I</p> <p>Describe the effect that asteroids or meteoroids have when moving through space and sometimes entering planetary atmospheres (e.g., meteor-"shooting star" and meteorite).V-J</p> <p>Explain that the universe consists of billions of galaxies that are classified by shape. II-A</p> <p>Explain interstellar distances are measured in light years (e.g., the nearest star beyond the sun is 4.3 light years away). I-E</p> <p>Examine the life cycle of a star and predict the next likely stage of a star. V-J</p> <p>Name and describe tools used to study the universe (e.g., telescopes, probes, satellites and spacecraft). II-F, C, V-K</p>
<i>Earth Systems</i>	Describe the rock cycle and explain that there are sedimentary, igneous and metamorphic rocks that have distinct properties (e.g., color, texture) and are formed in different ways. V-A	Explain the biogeochemical cycles which move materials between the lithosphere (land), hydrosphere (water) and atmosphere (air). II-H, V-E	Describe the interior structure of Earth and Earth's crust as divided into tectonic plates riding on top of the slow moving currents of magma in the mantle. V-A, B

	<p>Explain that rocks are made of one or more minerals. V-A, II-A</p> <p>Identify minerals by their characteristic properties. II-A, VI-A</p>	<p>Explain that Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) can change the environmental quality depending on the length of time involved (e.g. global warming). III-D, V-M</p> <p>Describe the water cycle and explain the transfer of energy between the atmosphere and hydrosphere. V-E</p> <p>Analyze data on the availability of fresh water that is essential for life and for most industrial and agricultural processes. Describe how rivers, lakes and groundwater can be depleted or polluted becoming less hospitable to life and even becoming unavailable or unsuitable for life. V-L, C</p> <p>Make simple weather predictions based on the changing cloud types associated with frontal systems. V-G, I-F</p> <p>Determine how weather observations and measurements are combined to produce weather maps and that data for a specific location at one point in time can be displayed in a station model. I-C, E</p> <p>Read a weather map to interpret local, regional and national weather. I-E</p> <p>Describe how temperature and precipitation determine climatic zones (biomes) (e.g., desert, grasslands, forests, tundra and alpine). V-F, G</p>	<p>Explain that most major geological events (e.g., earthquakes, volcanic eruptions, hot spots and mountain building) result from plate motion. V-B</p> <p>Use models to analyze the size and shape of Earth, its surface and its interior (e.g., globes, topographic maps, satellite images). I-C, II-C</p> <p>Explain that some processes involved in the rock cycle are directly related to thermal energy and forces in the mantle that drive plate motions. VI-I, V-B</p> <p>Describe how landforms are created through a combination of destructive (e.g., weathering and erosion) and constructive processes (e.g., crustal deformation, volcanic eruptions and deposition of sediment). V-B</p> <p>Explain that folding, faulting and uplifting can rearrange the rock layers so the youngest is not always found on top. V-B</p> <p>Illustrate how the three primary types of plate boundaries (transform, divergent and convergent) cause different landforms (e.g., mountains, volcanoes and ocean trenches). V-B</p>
--	---	---	--

		Describe the connection between the water cycle and weather-related phenomenon (e.g., tornadoes, floods, droughts and hurricanes). V-E, D, I-E	
--	--	--	--

Benchmarks for Standard V: 6-8

A. Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.

B. Explain that the universe is composed of vast amounts of matter, most of which is at incomprehensible distances and held together by gravitational force. Describe how the universe is studied by the use of equipment such as telescopes, probes, satellites and spacecraft.

C. Describe interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g., water cycle, weather and pollution).

D. Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.

E. Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).

Key to using this document:

- Items in bold with Roman numerals are COS standards.

- Items in regular print are state grade level indicators with the COS letter/number correlation.

- *Items in italics reference the Diocesan COS objectives that are not in state standards.*

- Bolded statements after each standard are state benchmarks for the grade span.

Content Standard V: Earth and Space Sciences 9-10

Organizers	Ninth Grade	Tenth Grade
<i>The Universe</i>	<p>Describe that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium. V-J, VI-I4</p> <p>Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the Big Bang, over 10 billion years ago. VI-I, II-J</p> <p>Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets and asteroids in the solar system. V-J</p> <p><i>Identify the members of the solar system and investigate the motion and relationship among them. V-I</i></p>	
<i>Historical Perspectives and Scientific Revolutions</i>	<p>Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., heliocentric theory and plate tectonics theory). III-H</p>	<p>Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geologic time scales, global warming, depletion of resources and exponential population growth). V-K, III-A, H</p>
<i>Earth Systems</i>	<p>Explain the relationships of the oceans to the lithosphere and atmosphere (e.g., transfer of energy, ocean currents and landforms). V-F</p> <p><i>Describe the water cycle. V-E</i></p> <p><i>Identify the properties of water. V-D</i></p> <p><i>Investigate solar energy and its effect.</i></p>	<p>Summarize the relationship between the climatic zone and the resultant biomes. (This includes explaining the nature of the rainfall and temperature of the mid-latitude climatic zone that supports the deciduous forest.) VI-H, I, V-E</p> <p>Explain climate and weather patterns associated with certain geographic locations and features (e.g., tornado alley, tropical hurricanes and lake effect snow). V-G, II-A</p> <p>Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). I-F</p> <p>Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere. IV-I, II-H</p> <p>Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life. V-L, III-D, E, H</p>

		Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers).II-H, V-M, L
<i>Processes That Shape the Earth</i>	<p><i>Identify and describe different types of materials in the lithosphere. V-A</i></p> <p><i>Identify the importance and uses of water. V-C</i></p> <p>Explain how the slow movement of material within Earth results from:</p> <ol style="list-style-type: none"> thermal energy transfer (conduction and convection) from the deep interior; the action of gravitational forces on regions of different density. V-B <p>Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding). V-B</p> <p>Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). V-B</p>	

Benchmarks for Standard V: 9-10

- A. Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe.**
- B. Explain that many processes occur in patterns within the Earth's systems.**
- C. Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record.**
- D. Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.**
- E. Explain the processes that move and shape Earth's surface.**
- F. Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.**

Key to using this document:

- Items in bold with Roman numerals are COS standards.**
- Items in regular print are state grade level indicators with the COS letter/number correlation.
- *Items in italics reference the Diocesan COS objectives that are not in state standards.*
- Bolded statements after each standard are state benchmarks for the grade span.**