SECONDARY SCIENCE CURRICULUM 9-12

Catholic Schools Office
Diocese of Phoenix
2014

SECONDARY SCIENCE CURRICULUM

Diocese of Phoenix
Updated 2014

MaryBeth Mueller, Ed. Specialist
Executive Director
Division of Education and Evangelization
and
Superintendent of Schools

Sr. Melita Penchalk, OSBM, Ed.S.
Assistant Superintendent

Cecilia Frakes, M.Ed.
Assistant Superintendent

Colleen McCoy-Cejka, M.A.
Assistant Superintendent

Catholic Schools Office
Diocese of Phoenix
400 East Monroe Street
Phoenix, AZ 85004
(602) 354-2345
www.catholicschoolsphx.com

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It is with much gratitude and praise that the Catholic Schools Office of the Diocese of Phoenix would like to recognize and thank the Secondary Science Curriculum Committee. In times when school curriculum is being more carefully scrutinized by the public and revised more carefully by educators in ways that will greatly impact the rigor of our Catholic school educational programs, this committee has done excellent work updating the Diocesan Standards to create a hearty curriculum that is reflective of core Catholic values.

As Catholic educators we value the perspective that science provides in the lens of our Catholic worldview. Our revised curriculum stresses the value we place on student inquiry, critical thinking and questioning, open-minded investigation, and reflective practices. Through science we hope to inspire curiosity, the desire to explore, and depth of learning within our students.

It is our intent as a committee to challenge our students and assist our teachers by providing the strongest curriculum guidance infused with our faith. In the end, we hope to produce students formed by Catholic philosophies who will be equipped to solve problems, think deeply and critically, and make informed, scientifically literate decisions rooted in moral responsibility. Our students will be well prepared to face the world in every regard.

Sincerely,

MaryBeth Mueller

MaryBeth Mueller, Ed. Specialist
Executive Director of the Division of Education and Evangelization
and Superintendent of Catholic Schools

SECONDARY SCIENCE
CURRICULUM STANDARDS COMMITTEE
2014

Renee Ashlock Bourgade Catholic High School Phoenix	Barbara Olivieri Seton Catholic Preparatory High School Chandler
Linda Pecora Notre Dame Preparatory Scottsdale	Gabriele Reil Xavier College Preparatory Phoenix
Kandi Wojtysiak Notre Dame Preparatory Scottsdale	Laurie Zentner St. Mary Catholic High School Phoenix
Mrs. Colleen McCoy-Cejka, M.A. Assistant Superintendent Diocese of Phoenix	Sr. Melita Penchalk, OSBM, Ed.S. Assistant Superintendent Diocese of Phoenix

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Diocese of Phoenix Science Curriculum K-12

Philosophy Statement

The universe is a place subject to fundamental scientific principles. An understanding of these principles will better prepare an individual to cope with a world in which rapid technological developments are taking place. As knowledge rapidly expands, it is most important for students to learn to make rational and moral decisions based upon scientific principles and their Catholic values. The skills and knowledge afforded students to make these types of decisions should reflect an appropriate level of intellectual and emotional growth. This curriculum is designed to stimulate curiosity and to develop morally responsible, scientifically literate citizens. This curriculum stresses the process of science as a way of learning and further emphasizes that scientific knowledge is always subject to change based on additional knowledge.

GOALS

All students will:

1. Develop an understanding of the processes and skills necessary for scientific investigation, problem solving, and critical thinking.

2. Develop responsible Catholic decision making skills in matters related to science and technology's impact on society with respect for the environment and all living things.

3. Recognize that science integrates mathematics, reading, oral and written communication, which are influenced by religious beliefs.

4. Develop interest, wonder, and curiosity about the study of the universe while recognizing the objective nature of science as created by God.

5. Develop an understanding of the scientific process and the structure of science, which includes organizing data into facts, principles, models, laws, and theories.

6. Realize the practical application of science in everyday life through technology and engineering.

National Standards and Benchmarks for effective Catholic Elementary and Secondary Schools March 2012

Academic Excellence:

The United States Conference of Catholic Bishops affirms the message of the Congregation on Catholic Education that intellectual development of the person and growth as a Christian go forward hand in hand. Rooted in the mission of the Church, the Catholic school brings faith, culture and life together in harmony. In 2005, the bishops noted that "young people of the third millennium must be a source of energy and leadership in our church and our nation. And, therefore, we must provide young people with an academically rigorous and doctrinally sound program of education" *(Renewing Our Commitment to Catholic Elementary and Secondary School is in the Third Millennium, 2005).*

The essential elements of "an academically rigorous and doctrinally sound program" mandate curricular experiences-including co-curricular and extra-curricular activities-which are rigorous, relevant, research-based, and infused with Catholic faith and traditions. The following essential elements provide a framework for the design, implementation, and assessment of authentic academic excellence in Catholic school education from pre-kindergarten through secondary school.

Standard 7: An excellent Catholic school has a clearly articulated, rigorous curriculum aligned with relevant standards, 21st century skills, and Gospel values, implemented through effective instruction. ***BENCHMARKS:***

7.1	The curriculum adheres to appropriate, delineated standards, and is vertically aligned to ensure that every student successfully completes a rigorous and coherent sequence of academic courses based on the standards and rooted in Catholic values.
7.2	Standards are adopted across the curriculum, and include integration of the religious, spiritual, moral, and ethical dimensions of learning in all subjects.
7.3	Curriculum and instruction for the 21st century learning provide students with the knowledge, understanding and skills to become creative, reflective, literate, critical, and moral evaluators, problem solvers, decision makers, and socially responsible global citizens.
7.4	Curriculum and instruction for 21st century learning prepares students to become expert users of technology, able to create, publish, and critique digital products that reflect their understanding of the content and their technological skills.
7.5	Classroom instruction is designed to intentionally address the effective dimensions of learning, such as intellectual and social dispositions, relationship building, and habits of mind.
7.6	Classroom instruction is designed to engage and motivate all students, addressing the diverse needs and capabilities of each student, and accommodating students with special needs as fully as possible.
7.7	Faculty collaborate in professional learning communities to develop, implement and continuously improve the effectiveness of the curriculum and instruction to result in high levels of student achievement.
7.8	The faculty and professional support staff meet (arch) diocesan, state, and/or national requirements for academic preparation and licensing to ensure their capacity to provide effective curriculum and instruction.
7.9	Faculty and professional support staff demonstrate and continuously improve knowledge and skills necessary for effective instruction, cultural sensitivity, and modeling of Gospel values.
7.10	Faculty and staff engage in high quality professional development, including religious formation, and are accountable for implementation that supports student learning.

Standard 8: An excellent Catholic school uses school-wide assessment methods and practices to document student learning and program effectiveness, to make student performances transparent, and to inform the continuous review of curriculum and the improvement of instructional practices. BENCHMARKS:

8.1	School-wide and student data generated by a variety of tools are used to monitor, review, and evaluate the curriculum and co-curricular programs; to plan for continued and sustained student growth; and to monitor and assess faculty performance.
8.2	School-wide and aggregated student data are normed to appropriate populations and are shared with all stakeholders.
8.3	Faculty use a variety of curriculum-based assessments aligned with learning outcomes and instructional practices to access student learning, including formative, summative, authentic performance, and student self-assessment.
8.4	Criteria used to evaluate student work and the reporting mechanisms are valid, consistent, transparent, and justly administered.
8.5	Faculty collaborate in professional learning communities to monitor individual and class-wide student learning through methods such as common assessments and rubics.

Standard 9 An excellent Catholic school provides programs and services aligned with the mission to enrich the academic program and support the development of student and family life. BENCHMARKS*:*

9.1	School-wide programs for parents/guardians provide opportunities for parents/guardians to partner with school leaders, faculty, and other parents/guardians to enhance the educational experiences for the school community.
9.2	Guidance services, wellness programs, behavior management programs, and ancillary services provide the necessary support for students to successfully complete the school program.
9.3	Co-curricular and extra-curricular activities provide opportunities outside the classroom for students to further identify and develop their gifts and talents and to enhance their creative, aesthetic, social/emotional, physical, and spiritual capabilities.

INTRODUCTION

Science Teachers as Moral Educators *Updated 2014*

The introduction of ethics in science classes is not the only way to portray science as receptive to open-mindedness and critical questioning. But it is an effective way, and it places science squarely in the context in which it actually operates in society. In addition, the very methods of inquiry and standards of public reasoning that science advances can make a valuable contribution to the moral education of students, beginning whenever the study of science begins.

Although ethical questions cannot be answered by science alone it seems clear that a reasonable approach to an ethical question requires carefully attending to, and seeking out, all the relevant facts.* We strive to seek God in all things, recognizing parents as the primary moral educators of the child.**

**Michael S. Pritchard*
http://www.onlineethics.org/CMS/edu/precol/childrenreason.aspx#teacher

***(The Catechism of the Catholic Church #2221)*

THE SCIENCE PROCESS TERMINOLOGY

The processes of science are skills that are developing knowledge, concepts, and application across the curriculum. The processes are often referred to as the "hands-on" laboratory approach to science and must be used throughout the program. Each of the terms has been adapted from American Association for the Advancement of Science and Science Curriculum Improvement Studies, Next Generation Science Standards, and implies active student participation.

OBSERVING: Using the senses to gather information about objects and events in the environment. This skill includes using scientific instruments to extend the range of the human senses and the ability to differentiate relevant from non-relevant.

INQUIRING: Emanates from a student generated question. The student desires to understand scientific ideas or to develop knowledge. The student develops authentic, real world investigations which foster a deeper understanding.

CLASSIFYING: A method for establishing order on collections of objects or events. Students use classification systems to identify objects or events, to show similarities, differences, and interrelationships. It is important to realize that all classification systems are subjective and may change as criteria change. The test for a good classification system is whether others can use it.

MEASURING: A procedure for using instruments to determine the length, area, volume, mass, or other physical properties of an unknown quantity. It requires the proper use of instruments and the ability to calculate the measured results.

QUANTIFYING: The skill includes: number sense, computation, estimation, spatial sense, and higher order mathematical operations.

COMMUNICATING: Transmitting the results of observations and experimental procedures to others through the use of such devices as: graphs, charts, tables, written descriptions, technology, oral presentations, expository writing, etc. Communication is fundamental to science, because it is in exchanging ideas and results of experiments that knowledge is validated by others.

QUESTIONING: The formulating of original questions based on observations and experiences with an event in such a way that one can experiment to seek the answers.

RELATING: In the sciences, information about relationships can be descriptive or experimental. relationships are based on logical arguments that encompass all data. Hypothetical reasoning, deductive reasoning, coordinate graphing, the managing of variables, and the comparison of effects of one variable upon another contribute to understanding the major concepts of science.

INFERRING: An inference is a tentative explanation that is based on partial observations. Available data is gathered and an evaluation made based on the observed data. These judgments are never absolute and reflect what appears to be the most probable explanation at the time and are subject to change as new data is accumulated.

PREDICTING: Using previously-observed information to determine probable outcomes about future events.

FORMULATING HYPOTHESES: Stating a probable outcome for an occurrence based on observations and inferences. The validity of the hypothesis is determined from testing and data analysis.

IDENTIFYING AND CONTROLLING VARIABLES: Determining what elements in a given investigation will vary or change and what will remain constant. Ideally scientists will attempt to identify all the variables before an investigation is conducted. By manipulating one variable at a time they can determine how that variable will affect the outcome.

EXPERIMENTING: Experimentation often begins with observations, which lead to questions that need answers. The steps for proceeding may include forming a hypothesis, identifying and controlling variables, designing the procedure for conducting tests, implementing tests, collecting and interpreting the data and reaching a conclusion.

APPLYING: The process of inventing, creating, problem solving, and determining probabilities are applications of using knowledge to discover further information.

CONSTRUCTING MODELS: Developing physical or mental representations to explain an idea, object or event. Models are usually developed on the basis of an acceptable hypothesis.

CODE

Strand 1:	Inquiry Process The Next Generation Science Standards (NGSS) built the Inquiry Process objectives into the based standards, and thus are not included.
PO	Performance Objective
DPO	Diocesan Performance Objective (unique to Diocese of Phoenix)
NGSS Standard	Next Generation Science Standards (June 2013)
HS	High School
MS	Middle School
HS	High School
ESS	Earth and Space Science
LS	Life Science
PS	Physical Science
ETS	Engineering, Technology and Applications of Science or Engineering Design
Page No.	Page in June 2013 NGSS Document

This document is a full revision of the 2008 Science Curriculum Standards, Secondary Science 9-12 Catholic Schools Office, Diocese of Phoenix, September 2008, to include and reference the Next Generation Science Standards of June 2013. It is recommended that the reader review the clarification statements and assessment boundaries of the NGSS in writing course curricula.
If a term is not self explanatory, please refer to the Glossary or Appendices.

SECONDARY SCIENCE CURRICULUM STANDARDS

Strand 1: Inquiry Process

Inquiry Process establishes the basis for students' learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results. *The Next Generation Science Standards (NGSS) built the Inquiry Process objectives into the topic-based standards, and thus are not included in this section. See the NGS Standards for specific information.*

Concept 1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.	
PO 1.	Evaluate scientific information for relevance to a given problem.
PO 2.	Develop questions from observations.
PO 3.	Formulate a testable hypothesis.
PO 4.	Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring)

Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.	
PO 1.	Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, and organisms) and behavior in all science inquiry.
DPO 2.	Identify the resources needed to conduct an investigation. • Differentiate between a controlled experiment and a natural experiment.
DPO 3.	Design an appropriate protocol (written plan of action) for testing a hypothesis: • Identify dependent and independent variables in a controlled investigation. • Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes). • Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, spreadsheet programs, journals (logs), charts, computers, calculators).
PO 4.	Conduct a scientific investigation that is based on a research design.
PO 5.	Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

Strand 1: Inquiry Process

Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results, and propose further investigations. Design models.	
PO 1.	Interpret data that show a variety of possible relationships between variables, including: • Positive relationship • Negative relationship • No relationship • Inverse • Direct
PO 2.	Evaluate whether investigational data support or do not support the proposed hypothesis.
DPO 3.	Evaluate conclusions of scientific studies (e.g., published papers, student reports).
DPO 4.	Evaluate the design of an investigation to identify possible sources of procedural error, including: • Sample size • Trials • Controls • Analyses • Accuracy & precision (i.e. % error) • Experimenter bias • Measurement & units
PO 5.	Design models (conceptual or physical) of the following to represent "real world" scenarios, for example: • Carbon cycle • Water cycle • Phase change • Collisions (macro or micro scale)
DPO 6.	Use descriptive statistics to analyze data, including: • Mean • Frequency • Range • Accuracy and Precision • Probability
PO 7.	Propose further investigations based on the findings of a conducted investigation.

Strand 1: Inquiry Process

Concept 4: Communication Communicate results of investigations.	
DPO 1.	Produce graphs that communicate data. • Use technology (calculator, computer etc.) or hand written methods as appropriate to data.
DPO 2.	Communicate results clearly and logically, for example: • Written reports: following format appropriate to the scientific discipline (see Appendix 1). • Mathematically: with proper scientific notation, ratio, proportion, algebraic relationships as appropriate. • Orally: expressing and defending results, group discussion or formal speaking.
DP3.	Support conclusions with logical scientific arguments specifically citing experimental results.

Strand 2: History and Nature of Science

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists and religions play in the development of various cultures. (See Appendix 2 for American Bishops' statements on ethical and religious directives.)

Concept 1: History of Science as a Human Endeavor Identify individual, cultural, religious, and technological contributions to scientific knowledge.		**NGS Standards**	**Page No.**
PO 1.	Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.	HS-ESS3-1	102
DPO 2.	Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations and concepts.		
PO 3.	Analyze how specific changes in science have affected society.	HS-PS4-2	89
DPO 4.	Analyze how specific cultural, religious, and/or societal issues promote or hinder scientific advancements.		

Concept 2: Nature of Scientific Knowledge Understand how science is a process for generating knowledge.		**NGS Standards**	**Page No.**
DPO 1.	Specify the requirements to establish a valid, scientific theory, including that it be: • Logical • Subject to peer review • Public • Respectful of rules of evidence	HS-PS4-4	89
DPO 2.	Explain how accepted ideas are challenged or extended by scientific innovation.		
PO 3.	Distinguish between pure and applied science, technology and engineering practices.		
PO 4.	Describe how scientists continue to investigate and critically analyze aspects of theories.	HS-PS4-3	89

Strand 2: History and Nature of Science

Diocesan Concept 3: Catholic Ethics in use of scientific information Understand the impact of science on human activity, the environment, and Christian decision making, and are proficient in the uses of technology as they relate to science.	
DPO 1.	Understand that Catholic teachings are rooted in a commitment to promote and defend human dignity; this is the foundation of its concern to respect the sacredness of every human life from the moment of conception until death.
DPO 2.	Discuss issues that contradict Catholic ethical teachings. Scientific pursuits should conform to that morality, for example: • Stem cell research • Appropriate use of laboratory animals in experimentation and research • Use of natural resources • Availability and testing in medical technology • Nuclear energy issues • Space exploration • Research for military applications • Not limited to the above

Diocesan Strand 3: Science in Personal, Social, and Spiritual Perspectives

Science in Personal, Social, and Spiritual Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, Catholic decision making and the ways people are involved in each. Students understand the impact of science and technology on human activity and the environment. This Strand affords students the opportunity to understand their place in the world – as living creatures, consumers, Catholic decision makers, problem solvers, managers, and planners. Students will apply the scientific thought processes of skepticism, objectivity and logic to seek solutions to issues with personal, social and spiritual aspects. (See Appendix 2)

Concept 1: Changes in Environments Describe the interactions between human populations, natural hazards, and the environment.		**NGS Standards**	**Page No.**
DPO 1.	Evaluate how the processes of natural ecosystems affect, and are affected by, humans.	HS-LS2-7 HS-ESS3-1	93 102
DPO 2.	Describe the effects of natural and/or human-caused hazards, for example: • Flooding • Drought • Earthquakes • Fires • Pollution • Extreme weather • Global climate change • Not limited to the above	HS-ESS3-1	102
DPO 3.	Assess how human activities, such as those listed, can affect the potential for hazards: • Industrial activity • Agriculture • Forestry • Range (grazing) • Water management • Personal lifestyle choices • Not limited to the above	HS-PS2-6 HS-PS4-4 HS-ESS3-1	85 89 102
DPO 4.	Propose appropriate safety measures that can be taken in preparation for : • Geologic disasters • Human made disasters • Severe weather disasters • Not limited to the above		

DPO 5.	Evaluate factors that affect the quality of the environment, for example: • Recycling • Green choices • Stewardship of resources • Urban development • Natural and man-made pollution sources • Not limited to the above	HS-LS2-7 HS-ESS3-4	93 102
DPO 6.	Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality, biodiversity, and sustainability.	HS-LS2-7 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4	93 102
DPO 7.	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.	HS-ESS2-2 HS-ESS3-5	100 102
DPO 8.	Use a computational representation to illustrate the relationships among Earth systems, and how those relationships are being modified due to human activity.	HS-ESS3-6	102

Diocesan Concept 2: Science and Technology in Society Develop viable solutions to a need or problem.		**NGS Standards**	**Page No.**
DPO 1.	Analyze the costs, benefits, and risks of various ways of dealing with issues arising from science and technology, for example: • Various forms of alternative energy • Storage of nuclear waste • Abandoned mines • Greenhouse gases • Hazardous wastes • Water management • Not limited to the above	HS-PS4-4 HS-ESS3-2 HS-ESS3-4	89 102
DPO 2.	Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology and teachings of the Catholic Church.		
DPO 3.	Analyze multiple positions on science or technology issues.	HS-PS4-2 HS-PS4-4	89

Diocesan Concept 2: Science and Technology in Society (Continued)			
DPO 4.	Analyze the use of renewable and nonrenewable resources, for example: • Water • Land • Soil • Minerals • Air • Not limited to the above	HS-PS4-2 HS-ESS3-1 HS-ESS3-3	89 102
DPO 5.	Evaluate the effectiveness of methods used to manage natural resources.	HS-ESS3-1 HS-ESS3-3	102

Diocesan Strand 3: Science in Personal, Social, and Spiritual Perspectives

Diocesan Concept 3: Human Population Characteristics From the Catholic perspective, analyze factors that affect human populations.		**NGS Standards**	**Page No.**
DPO 1.	Analyze social factors that affect the growth of a human population, for example: • Affluence • Education • Health care • Cultural and spiritual influences • Management of natural resources and biodiversity • Not limited to the above	HS-ESS3-3	102
PO 2.	Describe biotic (living) and abiotic (nonliving) factors that affect human populations.	HS-ESS3-1	102
PO 3.	Predict the effect of a change in specific factors on a human population: • Birth rate • Death rate • Immigration • Emigration • Carrying capacity of the environment	HS-LS2-1 HS-ESS3-1 HS-LS2-6	93 102 93

Diocesan Strand 3: Science in Personal, Social, and Spiritual Perspectives

Diocesan Concept 4: Ethics in the development and use of scientific information The Catholic perspective teaches that life is sacred from the moment of conception to natural death.		**NGS Standards**	**Page No.**
DPO 1.	Analyze technology that raises social, moral, ethical and legal issues with respect to the sacredness of human life, for example: • Prevent or facilitate pregnancy • End of life • Quality of life • Disability • Processes such as cloning and embryonic stem cell research • Not limited to the above		
DPO 2.	Analyze technology that raises social, moral, ethical and legal issues with respect to animal life, for example: • Research with animal subjects • Humane treatment of animals • Not limited to the above	HS-LS2-7	93
DPO 3.	Analyze global issues as they impact humanity, for example: • Climate change • Resource management • Sustainability • Not limited to the above	HS-ESS3-1 HS-ESS3-5 HS-ESS3-6	102

Diocesan Concept 5: Engineering Design as an Ethical Response Develop viable solutions to a need or problem.		**NGS Standards**	**Page No.**
DPO 1.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	HS-LS2-7 HS-ETS1-1	93 104
DPO 2.	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	HS-LS2-7 HS-ETS1-2	93 104
DPO 3.	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	HS-LS2-7 HS-ESS3-4 HS-ETS1-3	93 102 104
DPO 4.	Use a computer simulation to model the impact of proposed solutions to a complex, real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	HS-LS4-6 HS-ESS3-3 HS-ETS1-4	96 102 104

Strand 4: Life Science

Life Science expands students' biological understanding of life by focusing on the characteristics of living things, the diversity of life, and how organisms and populations change over time in terms of biological adaptation, evolution and genetics. This understanding includes the relationship of structures to their functions and life cycles, interrelationships of matter and energy in living organisms, and the interactions of living organisms with their environment.

Concept 1: The Cell Understand the role of the cell and cellular processes.		**NGS Standards**	**Page No.**
PO 1.	Describe the role of energy in cellular growth, development, and repair, including photosynthesis and respiration.	HS-LS1-5 HS-LS1-6 HS-LS1-7	91
DPO 2.	Describe the form, function and cellular components of: • Prokaryotic cells • Eukaryotic cells	MS-LS1-1 MS-LS1-2 MS-LS1-3	61-62
DPO 3.	Describe how cells maintain homeostasis via feedback mechanisms.	HS-LS1-3	91
DPO 4.	Analyze mechanisms of transport of materials (e.g., water, ions, macromolecules) into and out of cells: • Passive transport • Active transport	HS-PS2-6 HS-LS1-2 HS-LS2-3	85 91 93
PO 5.	Describe the purposes and processes of cellular division (mitosis).	HS-LS1-4	91

Concept 2: Molecular Basis of Heredity Understand the molecular basis of heredity and resulting genetic diversity.		**NGS Standards**	**Page No.**
PO 1.	Analyze the relationships among nucleic acids (DNA, RNA), genes, and chromosomes.	HS-LS1-1 HS-LS3-1	91 95
PO 2.	Describe the molecular basis of heredity, in viruses and living things, including DNA replication and protein synthesis.	HS-LS1-1 HS-LS3-1	91 95
DPO 3.	Explain how genotypic variation occurs and results in phenotypic diversity, applying concepts of statistics and probability.	HS-LS3-3	95
DPO 4.	Describe how cells maintain genetic variation, for example: • New genetic combinations through meiosis and fertilization • Viable errors during replication • Mutations caused by environmental factors • Conjugation • Not limited to the above	HS-LS3-2	95

Concept 3: Interdependence of Organisms Analyze the relationships among various organisms and their environment.		**NGS Standards**	**Page No.**
DPO 1.	Analyze the relationships among organisms at different levels of organization: • Populations • Communities (group behavior) • Ecosystems • Biomes	MS-LS2-2 HS-LS2-2 HS-LS2-6 HS-LS2-8	63 93 93 93
DPO 2.	Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment (aerobic and anaerobic) as influenced by the cycling of matter.	HS-LS2-1 HS-LS2-3 HS-LS2-4	93 93 93
PO 3.	Assess how the size and the rate of growth of a population are determined by birth rate, death rate, immigration, emigration, and carrying capacity of the environment.	HS-LS2-1 HS-LS2-6	93 93

Concept 4: Biological Evolution Understand the scientific principles and processes involved in biological evolution.		**NGS Standards**	**Page No.**
DPO 1.	Identify and communicate the following components of natural selection, which can lead to speciation: • Potential for a species to increase its numbers • Genetic variability and inheritance of offspring due to mutation and recombination of genes • Finite supply of resources required for life • Selection by the environment of those offspring better able to survive and produce offspring	HS-LS4-1 HS-LS4-2	96 96
PO 2.	Explain how genotypic and phenotypic variation can result in adaptations that influence an organism's success in an environment by using statistics and probability.	HS-LS3-3 HS-LS4-3	95 96
PO 3.	Describe how the continuing operation of natural selection underlies a population's ability to adapt to changes in the environment and leads to biodiversity and the origin of new species.	HS-LS4-3 HS-LS4-4	96 96
DPO 4.	Predict how a change in an environmental factor (e.g., rainfall, habitat loss, and non-native species) can affect the number and diversity of species in an ecosystem, (increases in number of individuals, emergence of new species, and the extinction of other species.)	HS-LS4-4 HS-LS4-5	96 96

Concept 4: Biological Evolution (Continued) Understand the scientific principles and processes involved in biological evolution.			
DPO 5.	Analyze scientific data which supports the theory of evolution through natural selection over billions of years, resulting in present day biodiversity: • Fossil record • Nuclear chemistry • Geology • Molecular biology • Geographical distribution • Embryology	HS-PS1-8 HS-LS4-1	83 96
DPO 6.	Analyze the degree of relatedness among various species using a biological classification system, for example: • Cladistics • Phylogeny • Morphology • DNA analysis • Not limited to the above	HS-LS3-3	95
DPO 7.	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity (threatened or endangered species or genetic variation.)	HS-LS4-6	96

Concept 5: Matter, Energy, and Organization in Living Systems (including Human Systems) Understand the organization of living systems, and the role of energy within those systems.		**NGS Standards**	**Page No.**
DPO 1.	Describe the processes of photosynthesis and cellular respiration (aerobic and anaerobic) in terms of energy flow, reactants, and products.	HS-LS1-5 HS-LS1-7 HS-LS2-3	91 91 93
PO 2.	Describe the role of organic and inorganic chemicals (e.g., carbohydrates, proteins, lipids, nucleic acids, water, ATP) important to living things.	HS-PS2-6 HS-LS1-6	85 91
DPO 3.	Diagram(using mathematical representations) biogeochemical cycles in an ecosystem for example: • Water • Carbon • Nitrogen • Not limited to the above	HS-LS2-3 HS-LS2-4 HS-LS2-5	93 93 93
DPO 4.	Diagram the energy flow in an ecosystem through a food chain as represented mathematically through an energy or biomass pyramid.	HS-LS2-4 HS-LS2-5	93 93
DPO 5.	Describe the levels of organization from atoms, molecules, cells, tissues, organs, organ systems, organisms, populations, communities to ecosystems.	HS-LS2-8 HS-LS1-2	93 91

Strand 5: Physical Science

Physical Science affords students the opportunity to increase their understanding of the characteristics of objects and materials they encounter daily. Students gain an understanding of the nature of matter and energy, including their forms, the changes they undergo, and their interactions. By studying objects and the forces that act upon them, students develop an understanding of the fundamental laws of motion, knowledge of the various ways energy is stored in a system, and the processes by which energy is transferred between systems and surroundings.

Concept 1: Structure and Properties of Matter Understand physical, chemical, and atomic properties of matter.		**NGS Standards**	**Page No.**
DPO 1.	Describe substances based on their physical properties and chemical properties.	HS-PS1-1 HS-PS1-2 HS-PS2-6	83 83 85
DPO 2.	Explain the differences between physical and chemical changes.	MS-PS1-1 MS-PS1-2	54 54
DPO 3.	Predict properties of elements and compounds using trends of the periodic table, for example: • Metals • Non-metals • Bonding – ionic/covalent • Not limited to the above	HS-PS1-1 HS-PS1-2 HS-PS2-6	83 83 85
DPO 4.	Separate homogeneous or heterogeneous mixtures of substances based on their physical properties.		
DPO 5.	Describe the properties of electric charge and the conservation of electric charge, including Coulomb's Law and the relationship between electric current and magnetic fields.	HS-PS1-3 HS-PS2-4 HS-PS2-5 HS-PS3-5	83 85 85 87
PO 6.	Describe the following features and components of the atom: • Protons • Neutrons • Electrons • Mass • Number and type of particles • Structure • Organization	HS-PS1-8 HS-PS2-6	83 85

Strand 5: Physical Science - Concept 1: (Continued)			
DPO 7.	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	HS-PS1-8	83
DPO 8.	Describe the historical development of models of the atom (Democritus through the quantum mechanical model, including wave versus particle theory).	HS-PS4-3	89
DPO 9.	Explain the details of atomic structure, for example: • Electron configuration • Energy levels • Isotopes • Not limited to the above	HS-PS1-1 HS-PS1-8 HS-PS2-6	83 83 85

Concept 2: Motion and Forces Analyze relationships between forces and motion.		**NGS Standards**	**Page No.**
DPO 1.	Determine the rate of change of a quantity, for example: • Rate of reaction • Velocity • Acceleration • Power • Not limited to the above	HS-PS1-5 HS-PS2-1	83 85
DPO 2.	Analyze relationships, graphically and mathematically, for example: • Position • Velocity • Acceleration • Time • Not limited to the above	HS-PS2-1	85
DPO 3.	Explain how Newton's 1st Law of Motion applies to objects at rest or moving at constant velocity.	MS-PS2-2 HS-PS2-3 HS-ESS1-4	56 85 98
DPO 4.	Using Newton's 2nd Law of Motion, analyze, graphically and mathematically, the relationships among the net force acting on a body, the mass of the body, and the resulting acceleration.	HS-PS2-1	85
DPO 5.	Use Newton's 3rd Law of Motion to explain forces as interactions between objects.	HS-PS2-2 HS-PS2-3 HS-PS3-5	85 85 87
PO 6.	Analyze the two-dimensional motion of objects by using vectors and their components.	HS-PS2-1	85

Concept 2: Motion and Forces (Continued)		NGS Standards	Page No.
DPO 7.	Model the independence of the horizontal and vertical components of projectile motion.	HS-PS2-1	85
PO 8.	Analyze the general relationships among force, acceleration, and motion for an object undergoing uniform circular motion.	HS-PS2-1 HS-PS2-3	85
PO 9.	Represent the force conditions required to maintain static equilibrium.	HS-PS2-1 HS-PS2-2	85
PO 10.	Describe and quantify the nature and magnitude of frictional forces.		
DPO 11.	Using the Law of Universal Gravitation, calculate how the gravitational force will change when the distance between two masses changes or the mass of one of them changes.	HS-PS2-4	85
DPO 12.	Using Coulomb's Law, calculate and model how the electrical force will change when the distance between two point charges changes or the charge of one of the point charges changes.	HS-PS2-4 HS-PS3-5	85
DPO 13.	Calculate and model how magnetic forces change as a result of the following: • Distance between objects • Magnetic poles • Electric current • Charge	HS-PS3-5	87
DPO 14.	Calculate the force required to produce a change in momentum.	HS-PS2-2	85
PO 15.	Quantify interactions between objects to show that the total momentum is conserved in both collision and recoil situations.	HS-PS2-2	85
DPO 16.	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	HS-PS2-3	85

Concept 3: Conservation of Energy and Increase in Disorder Understand ways that energy is conserved, stored and transferred.		**NGS Standards**	**Page No.**
DPO 1.	Describe the following ways in which energy is stored in a system, for example: • Mechanical • Electrical • Chemical • Nuclear • Not limited to the above	HS-PS1-8 HS-PS3-1 HS-PS3-2 HS-PS3-3 HS-LS1-5	83 87 87 87 91
DPO 2.	Describe, design, build, and refine devices and mechanisms that model the various ways in which energy is transferred from one system to another, for example: • Mechanical contact • Thermal conduction • Electromagnetic radiation • Not limited to the above	HS-PS2-5 HS-PS3-2 HS-PS3-3 HS-PS3-5 HS-LS1-5 HS-LS1-7	85 87 87 87 91 91
DPO 3.	Recognize that energy is conserved in a system by creating a computational model to calculate the change in the energy of one component in a system when either of the following occurs: • Change in components'energy • Movement of energy in or out of the system	HS-PS3-1 HS-PS3-3	87
PO 4.	Calculate quantitative relationships associated with the conservation of energy.	HS-PS3-1	87
DPO 5.	Analyze evidence of the movement of thermal energy in a closed system revealing the relationship between energy transfer (enthalpy) and disorder (entropy) in Universe as stated by Newton's 2nd Law of Thermodynamics.	HS-PS3-3 HS-PS3-4	87
DPO 6.	Model the movement and entropy of particles at absolute zero as stated in the 3rd Law of Thermodynamics, differentiating between temperature as a measure of kinetic energy and heat.		
PO 7.	Explain how molecular motion is related to temperature and phase changes.	HS-PS3-2	87
DPO 8.	Explain and apply the law of conservation of energy.	HS-PS3-1	87

Strand 5: Physical Science

Concept 4: Chemical Reactions Investigate relationships between reactants and products in chemical reactions.		**NGS Standards**	**Page No.**
PO 1.	Apply the law of conservation of matter to changes in a system.	HS-PS1-7	83
DPO 2.	Identify the indicators of chemical change, for example: • Formation of a precipitate • Evolution of a gas • Color change • Absorption or release of heat energy • Not limited to the above	HS-PS1-4	83
PO 3.	Represent a chemical reaction by using a balanced equation.	HS-PS1-2 HS-PS1-7	83
DPO 4.	Distinguish among the types of intramolecular bonds (ionic, covalent, metallic) as well as the resulting intermolecular forces (e.g. hydrogen bonding).	HS-PS1-1 HS-PS1-3	83
DPO 5.	Define and describe the mole concept and its relationship to Avogadro's number.	HS-PS1-7	83
DPO 6.	Solve problems involving such quantities as moles, mass, particles, volume of a gas, and concentrations using the mole concept and Avogadro's number.	HS-PS1-7	83
DPO 7.	Predict the properties of substances based upon bond type and intermolecular forces for example: • Melting point • Boiling point • Conductivity • Solubility • Not limited to the above	HS-PS1-1 HS-PS1-2 HS-PS1-3 HS-PS1-4	83
DPO 8.	Quantify the relationships between reactants and products in chemical reactions for example: • Stoichiometry • Equilibrium • Energy transfers • Not limited to the above	HS-PS1-6 HS-PS1-7	83

Concept 4: Chemical Reactions (Continued)			
DPO 9.	Predict the products of a chemical reaction using types of reactions for example: • Synthesis • Decomposition • Replacement • Combustion • Not limited to the above	HS-PS1-2 HS-PS2-6	83 85
PO 10.	Explain the energy transfers resulting from changes in bond energies within chemical reactions using the law of conservation of energy.	HS-PS1-4 HS-PS3-2	83 87
DPO 11.	Predict the effect of various factors on the equilibrium state and on the rates of chemical reaction for example: • Temperature • Concentration • Pressure • Catalyst • Not limited to the above	HS-PS1-5 HS-PS1-6 HS-PS2-6	83 83 85
DPO 12.	Compare the characteristics, behavior, concentration, and strengths of acids and bases.	HS-PS2-6	85
DPO 13.	Explain and apply the concept of electron transfer in oxidation-reduction reactions.	HS-PS1-2	83

Concept 5: Interactions of Energy and Matter Understand the interactions of energy and matter.		**NGS Standards**	**Page No.**
DPO 1.	Describe various ways in which matter and energy interact for example: • Photosynthesis • Phase change • Weathering and erosion • Not limited to the above	HS-PS2-5 HS-PS3-5 HS-PS4-5 HS-LS1-5	85 87 89 91
DPO 2.	Describe and quantify wave relationships, particularly those of the electromagnetic spectrum, between: • Wavelength • Frequency • Period • Amplitude • Types (Longitudinal and transverse) • Velocity • Speed of light • Media	HS-PS4-1 HS-PS4-3	89

Concept 5: Interactions of Energy and Matter (Continued)			
DPO 3.	Evaluate various applications of waves and the technological devices used to transmit information, such as: • Digital transmission and storage of information • Popular claims of effects of electromagnetic radiation	HS-PS4-2 HS-PS4-4	89
DPO 4.	Evaluate the evidence and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	HS-PS4-3	89
DPO 5.	Describe quantitatively the basic assumptions of kinetic molecular theory to the behavior of all states of matter, for example: • Gas laws • Changes of state • Density • Not limited to the above	HS-PS3-2	87
DPO 6.	Analyze calorimetric measurements in simple systems and the energy involved in: • Chemical reactions • Changes in physical state • Not limited to the above	HS-PS3-1	87
DPO 7.	Explain the relationship between the wavelength of light absorbed or released by an atom (e.g., Bohr) or molecule (e.g., photosynthesis) and the transfer of a discrete amount of energy.	HS-PS4-3 HS-PS4-4	89
DPO 8.	Describe and quantify the relationship among electric potential, current, and resistance in an ohmic system.	HS-PS3-5	87
DPO 9.	Describe and quantify the reflection, refraction and diffraction of waves as they interact with matter.	HS-PS4-1	89

Strand 6: Earth and Space Science

Earth and Space Science provides the foundation for students to develop an understanding of the Earth, its history, composition, and formative processes, and an understanding of the solar system and the universe. Students study the regularities of the interrelated systems of the natural world. In doing so, they develop understandings of the basic laws, theories, and models that explain the world. By studying the Earth from both a historical and current time frame, students can make informed decisions about issues affecting the planet on which they live.

Concept 1: Geochemical Cycles Analyze the interactions between the Earth's structures, atmosphere, and geochemical cycles.		**NGS Standards**	**Page No.**

DPO 1.	Model, quantitatively and qualitatively, how matter is cycled within the Earth system, in the following cycles:
	• Geochemical cycles:
	  o Carbon
	  o Nitrogen
	  o Phosphorous
	  o Sulfur
	• Water cycle
	• Rock cycle
		HS-ESS2-1
		HS-ESS2-5
		HS-ESS2-6
			100

DPO 2.	Demonstrate how dynamic processes relate to redistribution of materials within the Earth system, for example: • Weathering • Erosion • Sedimentation • Metamorphism • Orogenesis • Not limited to the above		
DPO 3.	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	HS-ESS2-5	
DPO 4.	Explain and model how the cycling of matter by thermal convection is related to plate tectonics, and the formation of continental and ocean-floor features.	HS-ESS2-1 HS-ESS2-3	100
DPO 5.	Explain and model, using feedback loops, how the hydrosphere, biosphere, lithosphere, cryosphere, and atmosphere are linked (e.g., Gaia theory).	HS-ESS2-2 HS-ESS2-7	100
DPO 6.	Describe and analyze the factors that impact current and future water quantity and quality, including: • Surface ground, and local water issues • Reclamation and conservation of water • Not limited to the above		
DPO 7.	Explain how the geochemical processes are responsible for the concentration of economically valuable minerals and ores in Arizona and worldwide.		

Strand 6: Earth and Space Science

Concept 2: Energy in the Earth System (Both Internal and External) Understand the relationships between the Earth's land masses, oceans, and atmosphere.		**NGS Standards**	**Page No.**
PO 1.	Describe and model the flow of energy to and from the Earth, which affects climate change.	HS-PS3-1 HS-ESS2-4	87
PO 2.	Explain the mechanisms of heat transfer (convection, conduction, radiation) among the atmosphere, land masses, and oceans.	HS-PS3-1	87
PO 3.	Distinguish between weather and climate.		
Internal Energy:			
DPO 4.	Demonstrate the relationship between the Earth's internal structure, convective heat flow, and plate tectonics.	HS-PS3-2 HS-ESS2-1 HS-ESS2-3	87 100
DPO 5.	Describe and model how plate tectonics cause the following: • Earthquakes • Volcanoes • Mountain ranges • Mid-oceanic ridges • Deep sea trenches	HS-ESS1-5	98
DPO 6.	Distinguish and analyze the seismic evidence using S and P waves and surface waves to determine the structure of the Earth.	HS-ESS1-5	98
DPO 7.	Describe how radioactive decay maintains the Earth's internal temperature.	HS-PS1-8	83

Concept 2: Energy in the Earth System (Continued) **External Energy:**			
DPO 8.	Describe and explain the effects of heat transfer on climate and weather.	HS-PS3-1 HS-PS3-2 HS-ESS2-4	87 87 100
DPO 9.	Model and explain the effect of the Earth's rotation, the Coriolis effect, on the movement of water and air.		
DPO 10.	Describe the origin, cycle and behavior of weather systems, including: • Air masses • Fronts • High and low systems • Pressure gradients Not limited to the above		
DPO 11.	Describe the conditions that cause severe weather, including: • Hurricanes • Tornadoes • Thunderstorms • Not limited to the above		
DPO 12.	Analyze how weather is influenced by both natural and artificial features, for example: • Bodies of water • Mountain ranges • Urbanization • Not limited to the above		
DPO 13.	Describe the physical factors that determine climate, including: • Altitude • Latitude • Water bodies • Precipitation • Prevailing winds • Topography • Not limited to the above		
DPO 14.	Explain the causes and effects of climate changes over geological time, for example: • Desertification • Glaciation • Greenhouse effect • Solar activity • Not limited to the above		
DPO 15.	Investigate the effects of acid rain, smoke (forest fires and industrial exhaust), volcanic dust, urban development, and greenhouse gases, on weather and climate change over varying periods of time.	HS-ESS2-4	100

Strand 6: Earth and Space Science

Concept 3: Origin and Evolution of the Earth System Analyze the factors used to explain the history and evolution of the Earth.		**NGS Standards**	**Page No.**
Earth Origin/System:			
PO 1.	Describe the scientific theory of the origin of the solar system (solar nebular hypothesis).	HS-ESS1-2 HS-ESS1-6	98
DPO 2.	Describe the characteristics, location, gravitational force, and motion of the various kinds of objects in our solar system, including: • Asteroids • Comets • Meteors • Planets • Satellites • Sun • Not limited to the above.	HS-ESS1-4	98
PO 3.	Describe and model the phases of the Moon, eclipses (lunar and solar), and the interaction of the Sun, Moon, and Earth (tidal effects).		
Earth History/Evolution:			
DPO 4.	Using evidence, construct and interpret a geologic time scale.	HS-ESS1-5 HS-ESS1-6	
DPO 5.	Describe and model the differences between relative and absolute geologic dating techniques.		
DPO 6.	Sequence major events in the Earth's evolution (e.g., Earth's formation, mass extinctions, glacial episodes) using relative and absolute dating data.	HS-ESS1-6	
DPO 7.	Investigate scientific theories of how life originated on Earth, for example: • Deep sea vent theory • Panspermia • Primordial soup theory • Not limited to the above	HS-ESS2-7	100
DPO 8.	Describe how life on Earth has influenced the evolution of the Earth's physical and geochemical systems.		
PO 9.	Analyze patterns in the fossil record related to the theory of biological evolution.		

Strand 6: Earth and Space Science

Concept 4: Origin and Evolution of the Universe Analyze the factors used to explain the origin and evolution of the universe.		**NGS Standards**	**Page No.**
DPO 1.	Describe the Big Bang Theory as one explanation for the origin of the universe, including astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	HS-ESS1-2	98
PO 2.	Describe how the fusion process that takes place in stars produces elements: • lighter elements in stars. • heavier elements (what astronomers call "metals") in supernova explosions.	HS-ESS1-3	98
PO 3.	Analyze the evolution of various types of stars, particularly the Sun and its release of energy, using the Hertzsprung-Russell (HR) diagram.	HS-ESS1-1	98
PO 4.	Compare the life cycles of stars of different masses (low and high mass).	HS-ESS1-1	98
PO 6.	Explain the life cycles of galaxies.		

SELECTION OF MATERIALS:

SECONDARY SCIENCE—

Selection of materials is to be an on-site process based on the needs and abilities of the demographic population within the school. The materials chosen should be consistent with the Secondary Science Standards of the Diocese of Phoenix.

APPENDICES

APPENDIX 1 – LAB REPORT GRADING RUBIC

20 points possible

MLA format: ____ 1 point possible

Lab Title: ____

Section Headings: ____

Introduction:

1) Statement of problem (answering the question "what was investigated?"): ____ 3 points possible
   Comments:

2) Statement of purpose (answering the question "why was this problem studied?"): ____ 3 pts possible
   Comments:

3) Background information (what information does the reader need to know to understand the lab?):
   ____ 4 points possible
   ____ Definitions of all scientific terms used
   ____ Scientific laws described and explained
   ____ All formulas and units described and explained
   Comments:

4) General method (a one-sentence summary of how the lab was done): ____ 3 points possible
   Comments:

5) Expected results and hypothesis (what did the author expect the outcome to be, and why?):
   ____ 4 points possible
   Comments:

Method & Materials, Results, and Conclusion: ____ included, 1 point possible
Comments:

References: ____, 1 point possible

Total points earned: _____

Lab Report Guide

1) What is the lab title? _____
2) Include each section's heading: Introduction, Methods & Materials, Results, Conclusion
3) The introduction should include:
   a) a statement or description of what was investigated:
      i) _____
   b) An explanation of why that phenomenon was being studied:
      i) _____
   c) How the problem was investigated in a one or two sentence description of the method:
      i) _____
   d) Pertinent background information:
      i) What further information is needed to understand what is happening in the lab?
         _____
         _____
      ii) What technical terms are used to describe scientific laws in action, procedures in the lab, observations, etc.?_____
      iii) What laws and terms need to be defined? _____
      iv) What formulas are used? What do those formulas mean? _____
   e) A description of the person's expectations for their results and/or a hypothesis:
      i) What was expected to happen? Why? _____
         _____
4) The methods and materials section should include both the method and a complete list of materials:
   a) List the method, and note any changes, gaps, or inconsistencies in the procedure:
      _____
   b) Was the procedure written as a set of instructions, in the present tense? For example, "first, obtain the needed reactants." yes no
      i) If so, rewrite the first step as a description of what was done, in past tense. For example, "first, the needed reactants were obtained." _____
         _____
   c) Note any missing materials – is anything discussed in the procedure, but not listed in the materials? If so, add them. _____

5) When the results section provides a data table or graph, are the data also described in full sentences? If not, add them.
   a) Consider all data. Describe all connections and relationships between quantitative and qualitative data. For example, "at 8 degrees Celsius, all ice had melted."
   b) Using the titles of graphs or charts, describe what the graph or chart shows.
6) Does the results section include any statements comparing or drawing conclusions about the data? For example, "the first chemical was the most reactive" or "these results show that some chemicals are reactive and some are not." Underline these statements to show which sentences need to be moved to the conclusion section.

7) The conclusion section should:
   a) reflect on whether the expected results or hypothesis in the introduction were observed or supported? Give an explanation of why the hypothesis was either supported or not supported:

      _____

      _____

   b) include responses to the analysis and conclusion prompts in the lab packet.
   c) reflect on the procedure used this lab? What should be done differently if the lab were to be repeated? What might have affected the accuracy of the data?

      _____

8) Correct grammar for 3rd person passive tense:
   a) Reread the paper, and circle all pronouns: I, you, he, she, they, we, my, yours, ours, theirs
   b) In the first sentence using I, we, my, our, change the sentence so the sentence reads "x, y, and z were done."
   c) Avoid 3rd person active constructions, such as "the student observed a gas." This sentence should be "A gas was observed."
   d) Fix all mistakes.

9) Include all references, or sources of information, used in this lab, including the textbook and any websites. List in MLA format.

Lab Report Proofreading and Revision Guide

1) Does the report have a lab title? yes no
2) Does the report have an introduction, a single method and materials section, a results section, and a conclusion? List any missing:

   _____

   a) Does each section have a heading? yes no
3) Does the introduction include:
   a) a statement or description of what was investigated? yes no
      i) What was it?

      _____

   b) An explanation of why that phenomenon was being studied? yes no
      i) Which was?

      _____

   c) How the phenomenon was investigated in a short recap of the method? yes no
      i) What was done?

      _____

   d) Pertinent background information? yes no
      i) is there further information that would be helpful to you, as the reader, in understanding what this person was doing? If so, what?

      _____

      _____

   e) A description of the person's expectations for their results and/or a hypothesis? yes no
      i) What were their expected results?

      _____

      _____

4) Does the methods and materials section include both the method and a complete list of materials? yes no If no, what is missing?

   _____

   a) Read the method, and note any questions you have about apparent gaps or inconsistencies in the procedure:

      _____

   b) Was the procedure written as a set of instructions, in the present tense? For example, "first, obtain the needed reactants." yes no

i) If so, rewrite the first step as a description of what was done, in past tense. For example, "first, the needed reactants were obtained."

_____

_____

c) Note any missing materials – is anything discussed in the procedure, but not listed in the materials? yes no

_____

5) If the results section provides a data table or graph, are the data also described in full sentences? yes no
6) Does the results section include any statements comparing or drawing conclusions about the data? For example, "the first chemical was the most reactive" or "these results show that some chemicals are reactive and some are not." Underline these statements to show which sentences need to be moved to the conclusion section.
7) Does the conclusion section:
   a) reflect on whether the expected results or hypothesis in the introduction were observed or supported? Does the author give an explanation of why the hypothesis was either supported or not supported? If not, provide them with a short explanation based on your reading of the lab report:

   _____

   b) include responses to the analysis and conclusion prompts in the lab packet? yes no
   c) reflect on the procedure the student designed for this lab? What would they do differently if they were to repeat the lab?

   _____

8) Correct grammar for 3rd person passive tense:
   a) Reread the paper, and circle all pronouns: I, you, he, she, they, we, my, yours, ours, theirs
   b) In the first sentence using I, we, my, our, change the sentence so the sentence reads "x, y, and z were done."
   c) Avoid 3rd person active constructions, such as "the student observed a gas." This sentence should be "A gas was observed."
   d) Fix as many sentences as possible.
9) Additional comments:

APPENDIX 2 – SAMPLE FORMAT FOR SCIENTIFIC WRITING

Lab Format for an Introductory Science Lab Course

Include the following 10 parts unless otherwise instructed. (Point values are discretionary)

1. Testable Question: *(Think: What am I attempting to answer?)* **1 pts**

A question you can attempt to find the answer to in one experiment.
The typical question format is:
How is _____ related to _____ ?

2. Hypothesis: *(Think: What do I predict the answer is?)* **1 pts**

Use format: If … and … then …

3. Variables: *(Think: What am I going to measure?)* **3 pts**

List all the variables in your experiment.
Identify the nature of each variable (independent, dependent, control, etc.).

4. Design: *(Think: Organized and detailed plan.)* **3 pts**

This is a blueprint / layout of the planned measurements.
It takes the form of a table.
Order: Controls, independent variable, dependent variable
Example:

mass	distance	angle	time
m1	d1	a1-a8	t1-t8
m2	d1	a1-a8	t1-t8
m1	d2	a1-a8	t1-t8
etc.	etc.	etc.	etc.

Each line describes a set of data: For one mass (m1) and one distance (d1) (controls) the time (t) (Dependent Variable [DV]) will be measured for 8 different values of the angle (a1-8) (Independent Variable [IV]). We usually only have the first line, but another group will usually have different controls and thus appear to be doing the next lines.

5. Materials: *(Think: What do I need?)* **1 pt**

List the essential materials, but avoid the obvious such as paper and pencil.

6. Procedure: *(Think: How will I do it?)* **1 pt**

Give step-by-step instructions. Be brief and precise.
Use a drawing to illustrate the setup.

7. Data: *(Think: What did I measure?)* **3 pts**

Make a data table with all your measurements. Make sure to include your controls.
Use metric units. The use of metric prefixes is allowed.
Use the correct number of significant figures for your measurement.

8. Analysis: *(Think: Graphs and/or calculations?)* **6 pts**

Generally the independent variable is graphed on the x-axis and the dependent variable is graphed on the y-axis. Follow these rules for graphs:

- Title should reflect variables measured
- Labels and units on both axes
- Choose scales to fill out the graph paper (graph breaks where appropriate)
- Use consistently spaced scales
- Mark each data point clearly

Draw the best straight line through the points (if applicable) and find the slope.

9. Conclusion: *(Think: Answer the question in 1.)* **2 pts**

Answer the testable question in as precise a language as possible.

10. Evaluate your results: *(Think: Are they good? Do I trust my own results?)* **3 pts**

- Did you get the expected relationship?
- Was the original hypothesis supported by your data?
- Was the lab well designed, did the procedure work to test your hypothesis?
- Can you think of ways to improve it?
- Additional questions may be posed by the teacher specific to the particular lab.

******The following is an example of a lab format for a biology course.**

Title: Usually taken from lab worksheet

PROBLEM: *Always written in the form of a question*
Or
OBJECTIVE: *Statement of the purpose of the lab*

HYPOTHESIS*: If the lab is experimental a hypothesis is always included. This is simply a testable statement related to what you believe the results of an experiment should be:*

IF, AND, THEN - STATEMENTS:

If - restates the hypothesis in simpler terms
And - Describes the test to prove hypothesis
Then - Prediction of expected results

EXPERIMENTAL DESIGN: If there is a control in the experiment then the Independent (IV), Dependant (DV) and Controlled (CV) variables must be listed here.

- **IV –** the part of the experiment that is change on purpose (includes a control set-up)
- **DV –** The part of the experiment that is affected by the independent Variable
- **CV –** All the other items of the experiment that are used in each set-up

**If the experiment is simply an observation of an object (or phenomenon) then one simply states next to the Experimental Design – NO CONTROL and lists the materials needed for the experiment. (That is: If the experiment does not have an independent or dependant variable then simply list the materials to be used.)

PROCEDURE: Most experiments already have listed procedures (written in third person). In this case the student should *summarize the steps as if he/she were explaining to someone what they are about to do. ** If the student is designing the experiment on their own then precise directions should be written.*

DATA: (table and/or graph) *Data will be collected, recorded, and graphed (sometimes you will use the lab worksheet provided and other times you will need to create your own table and graphs). IF you use the lab worksheet, please cite the source that directs the reader to that information:* i.e. See attached Data Chart and Graphs

ANALYSIS:

- Students must describe their results using only concrete details (i.e. data, interpretations of graph)
- ALSO students must answer questions on a lab handout if supplied.

CONCLUSION: Must refer to your original hypothesis.

- Include a comparison statement to your original hypothesis.
- Supply data from the lab as support/refuting hypothesis
- If hypothesis was refuted, the student must supply a revised hypothesis

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Lab formats for each successive year in High School will take on different formatting but include the same information. One example is a different focus on Data collection (i.e. more observational for biology – forms of diagrams of results)

Student and Teacher Templates may also be found on the AP college board website.

APPENDIX 3
- HEALTH CARE DIRECTIVES FROM THE UNITED STATES CONFERENCE OF CATHOLIC BISHOPS

The following directives have been selected as specific examples pertinent to Diocesan Concept 3 and Strand 3 Diocesan Concept 4. To see the directives in their entirety, go to www.ncbcenter.org/C_D_directives.asp

Directive 36: While every person is obliged to use ordinary means to preserve *his/her* health, no person should be obliged to submit to a health care procedure that the person has judged, with a free and informed conscience, not to provide a reasonable hope of benefit without imposing excessive risks and burdens on the patient or excessive expense to family or community.

Directive 52: Catholic health institutions may not promote or condone contraceptive practices but should provide, for married couples and the medical staff… instruction both about the Church's teaching on responsible parenthood and in methods of natural family planning."

Directive 53: Direct sterilization of either men or women, whether permanent or temporary, is not permitted in a Catholic health care institution. Procedures that induce sterility are permitted when their direct effect is the cure or alleviation of a present and serious pathology and a simpler treatment is not available.

Directive 56: A person has a moral obligation to use ordinary or proportionate means of preserving *his* or *her* life. Proportionate means are those that in the judgment of the patient offer a reasonable hope of benefit and do not entail an excessive burden or impose excessive expenses on the family or community.

Directive 57: A person may forgo extraordinary or disproportionate means of preserving life. Disproportionate means are those that in the patient's judgment do not offer a reasonable hope of benefit or entail an excessive burden, or impose excessive expense on the family or community.

Directive 58: There should be a presumption in favor of providing nutrition and hydration to all patients, including patients who require medically assisted nutrition and hydration, as long as this is of sufficient benefit to outweigh the burdens involved to the patient.

Directive 60: Euthanasia is an action or omission which of itself or by intention causes death, in order to alleviate suffering. Catholic health care institutions may never condone or participate in euthanasia or assisted suicide in any way. Dying patients who request euthanasia should receive loving care, psychological and spiritual support, and appropriate remedies for pain and other symptoms so that they can live with dignity until the time of natural death.

Directive 61: Patients should be kept as free of pain as possible so that they may die comfortably and with dignity . . . Since a person has the right to prepare for his or her death while fully conscious, he or she should not be deprived of consciousness without a compelling reason....

Directive 63: Catholic health care institutions should encourage and provide the means whereby *those who wish to do so* may arrange for the donation of their organs and bodily tissue, for ethically legitimate purposes, so that they may be used for donation and research after death.

APPENDIX 4 – LIST OF BOOKS

Fiction:

Periodic Table Mysteries Series,	Minichino, Camille
A Swifty Tilting Planet	L'Engel, Madeleine
A Wrinkle in Time	L'Engel, Madeleine

Nonfiction:

A Swifty Tilting Planet	L'Engel, Madeleine
A Wrinkle in Time	L'Engel, Madeleine
Collapse	Diamond, Jared
Finding Darwin's God	Miller, Kenneth
Gulf, The Adventures of Alimentary Canal	Roach, Mary
Half the Sky	Kristoff, N. and WuDunn, S.
Periodic Table Mysteries Series,	Minichino, Camille
Plan B 4.0	Brown, Lester
Silent Spring	Carson, Rachel
Song for the Blue Ocean	Safina, Carl
Stiff, The Curious Lives of Cadavers	Roach, Mary
The Disappearing Spoon	Kean, Sam
The Double Helix	Watson, James
The Immortal Life of Henrietta Lacks	Skloot, Rebecca
The Man Who Mistook His Wife for a Hat	Sacks, Oliver
The Omnivores Dillema	Pollan, Michael
The Story of Stuff	Leonard, Annie
Uncle Tungsten	Sacks, Oliver

GLOSSARY

Science Standards
Arizona Department of Education – Standards Based Teaching and Learning
GLOSSARY

The purpose of this glossary is to help the user better understand and implement the Science Standards. It is not a comprehensive list of all science terms.

abiotic	nonliving
absorb	to take up (e.g., plant roots absorb water)
adaptation	hereditary features of organisms that allow them to live in a particular environment
affect	to have an influence on
affluence	plentiful supply of material goods; wealth
applied science	research aimed at answering questions that have practical applications, e.g., determining the causes of diseases so that cures might be found
asteroid	small rocky body orbiting the Sun
atmosphere	gaseous envelope surrounding the Earth
atom	smallest particle of an element that retains the chemical nature of the element
barometric pressure	atmospheric pressure as indicated by a barometer, used especially in weather forecasting
basic science	research designed to describe or explain nature to satisfy one's curiosity
bias	statistical sampling or testing error caused by systematically favoring some outcomes over others
biodiversity	1. number and variety of organisms found within a specified geographic region 2. variability among organisms, including the variability within and between species and within and between ecosystems
biome	broad area of the Earth's surface characterized by distinctive vegetation and associated animal life; e.g., broad-leaf forest biome, grassland biome, desert biome
biotic	relating to life or living organisms
calorimetric	relating to the measurement of heat energy by means of temperature measurements
camouflage	concealment by disguise or protective coloring
carrying capacity	maximum number of individuals that a given environment can support for a sustained period of time
catalyst	substance, usually used in small amounts relative to the reactants, that modifies and increases the rate of a reaction without being consumed in the process
cellular respiration	metabolic processes which break down nutrients into usable energy
circuit	1. closed path followed or capable of being followed by an electric current 2. configuration of electrically or electromagnetically connected components or devices
cirrus	high-altitude cloud composed of narrow bands or patches of thin, generally white, fleecy parts
characteristic	distinguishing trait, feature, quality, or property
cladistics	system of classification that constructs evolutionary trees, showing how shared derived characters can be used to reveal degrees of evolutionary relationships between existing and extinct species
classification system	method of organization of objects or organisms using distinct characteristics or features

classify	to arrange or organize according to class or category
climate	average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity and precipitation
comet	body of dust, ice, and gas, which orbits the Sun; the orbit is usually highly elliptical or even parabolic
community	group of plants and animals living and interacting with one another in a specific region under relatively similar environmental conditions
compound	substance formed from two or more elements chemically united in fixed proportions
conduction	process by which heat or electrical energy is transmitted through a material or body without gross motion of the medium itself
conifer	any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnosperm trees or shrubs such as pines, spruces, and firs
conservation	**Life science:** the protection, preservation, management, or restoration of wildlife and of natural resources such as forests, soil, and water, to prevent exploitation, destruction or neglect **Physical science:** a unifying principle of constancy of a quantity under specified conditions
constellation	formation of stars perceived as a figure or design, especially one of 88 recognized groups named after characters from classical mythology and various common animals and objects
consumer	organisms requiring complex organic compounds for food, which is obtained by preying on other organisms or by eating particles of organic matter
contrail	artificial cloud created by an aircraft, caused either by condensation due to the reduction in air pressure above the wing surface, or by water vapor in the engine exhaust
controlled investigation	investigation in which all but one variable remain constant
convection	transfer of heat energy in a gas or liquid by the circulation of currents of matter from one region to another
cumulus	dense, white, fluffy, flat-based cloud with a multiple rounded top and a well-defined outline, usually formed by the ascent of thermally unstable air masses
data	factual information, from observations, organized for analysis
decomposer	organisms such as bacteria and fungi that feed and break down dead organisms, returning constituents of organic substances to the environment
deformation	alteration of shape, as by pressure or stress
deposition	1. act of depositing, especially the laying down of matter by a natural process 2. something deposited; a deposit
distinguish	to perceive or indicate differences; discriminate
dominant	of, relating to, or being an allele that produces the same phenotypic effect whether inherited with a homozygous or heterozygous allele
DNA	(Deoxyribonucleic acid) double strand of nucleotides that is a self-replicating molecule present in living organisms as the main constituent of chromosomes; contains the genetic code and transmits the heredity pattern
ecology	study of the interactions and relationships between and among organisms and their environment
ecosystem	all the organisms in a given area and the abiotic factors with which they interact
eclipse	partial or complete obscuring, relative to a designated observer, of one celestial body by another
e.g.	abbreviation for *for example*; precedes a non-exhaustive list of examples provided as options; other examples may be appropriate but not included (compare to i.e.)

electron	negatively charged fundamental particle in an atom
element	any of more than 100 fundamental substances that consist of atoms of only one atomic number and that singly or in combination constitute all matter
environment	sum of all external conditions affecting the life, development and survival of an organism, including the biotic (living) and abiotic (non-living) elements
erosion	group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the Earth's surface
eukaryotic	referring to a cell with a nucleus and other internal structure
experimentation	act of conducting a controlled test or investigation
extinct	no longer in existence
fertilization	1. act or process of initiating biological reproduction by insemination or pollination 2. union of male and female gametes to form a zygote
food chain	arrangement of the organisms of an ecological community according to the order of predation in which each uses the next as a food source
food web	totality of interacting food chains in an ecological community
force	**K-6:** push or pull that changes the motion or shape of an object **7- HS:** vector quantity that tends to produce an acceleration of a body in the direction of its application
formulate	to devise or invent
frequency	ratio of the number of times an event occurs in a series of trials of a chance experiment to the number of trials of the experiment performed; the number of cycles an oscillating system executes in one second
friction	force that resists relative motion between two bodies in contact
front (weather)	interface between air masses of different temperatures or densities
gas	state of matter that does not have a definite shape or volume and is much less dense than a liquid because its molecules are far apart compared to their diameters
genotype	particular combination of genes in an organism
gravitation	universal force by which every body in the universe attracts every other body
gravity	attraction of the mass of the Earth, the Moon or a planet for bodies at or near its surface
greenhouse gas	atmospheric gas such as carbon dioxide, water vapor, and methane that allows incoming sunlight to pass through but absorbs infrared radiation radiated back from the Earth's surface, leading to the phenomenon whereby the Earth's atmosphere traps solar radiation
guided investigation	teacher-directed investigation
habitat	place or environment where a plant or animal naturally or normally lives and grows
hazardous waste	substance, such as nuclear waste or an industrial byproduct, that is potentially damaging to the environment and harmful to humans and other organisms
heredity	genetic transmission of characteristics from parent to offspring
heterogeneous	consisting of dissimilar elements or parts
homogeneous	uniform in structure or composition throughout

hydrosphere	aqueous envelope of the Earth, including the oceans, all lakes, streams, and underground waters, ice, and the aqueous vapor in the atmosphere
hypothesis	**K-5:** statement of an anticipated result of an investigation **6-HS:** proposed relationship among observable phenomena or an inferred explanation for those phenomena
i.e.	abbreviation for *that is*; precedes a specific list of items in which all of the items should be used (compare to e.g.)
igneous	relating to, resulting from, or suggestive of the intrusion or extrusion of magma or volcanic activity; rock formed from molten magma
inorganic	involving neither organic life nor the products of organic life **Chemistry:** of or relating to compounds not containing carbon
interdependence	state of organisms depending on each other and the environment for survival
interpretation	explanation
interrelationships	interactions between two or more objects or organisms
invertebrate	animal, such as an insect or mollusk, that lacks a backbone or spinal column
investigation	inquiry, research, or systematic examination
involuntary	not under the influence or control of the will; not voluntary; as, the involuntary movements of the body (involuntary muscle fibers)
isotope	any of two or more species of atoms of a chemical element with the same atomic number and nearly identical chemical behavior, but with differing atomic mass and mass number and different physical properties
law	statement that summarizes, identifies, or describes a relationship among observable phenomena
lever	simple machine consisting of a rigid bar pivoted on a fixed point and used to transmit force, as in raising or moving a weight at one end by pushing down on the other
limiting factor	conditions or resources that control the size of a population
liquid	state of matter that does not hold a definite shape but occupies a definite volume because its molecules are in close contact
lithosphere	outer part of the Earth, consisting of the crust and upper mantle, approximately 100 km (62 mi.) thick
living	state of being alive
lunar	of, involving, caused by, or affecting the Moon
macroscopic	large enough to be perceived or examined by the unaided eye; large compared to a microscopic object
mass	property of a body that is a measure of its inertia and causes it to have weight in a gravitational field, that is commonly taken as a measure of the amount of material it contains
matter	anything that possesses mass and occupies volume
mean	average value of a set of numbers
meiosis	type of cell division that occurs during the reproduction of diploid organisms to produce the gametes. The double set of genes and chromosomes of the normal diploid cells is reduced during meiosis to a single haploid set in the gametes. Crossing-over and, therefore, recombination occur during a phase of meiosis
metamorphic	change in the constitution of rock; specifically, a pronounced change affected by pressure, heat and water that results in a more compact and more highly crystalline condition; a rock produced by these processes

meteor	bright trail or streak that appears in the sky when a meteoroid is heated to incandescence by friction with the Earth's atmosphere; also called falling star, meteor burst, shooting star
microscopic	too small to be seen by the unaided eye but large enough to be studied under a microscope; small compared to a macroscopic object
mimicry	resemblance of one organism to another or to an object in its surroundings for concealment and protection from predators
mitosis	cell division; cell division in multicellular organisms occurs by mitosis except for the special division called meiosis that generates the gametes
mixture	portion of matter consisting of two or more components in varying proportions that retain their own properties
model	schematic description or representation of a system, theory, or phenomenon that accounts for at least some of its known or inferred properties and may be used for further study of its characteristics
molecule	smallest particle of a chemical substance that retains all the properties of the substance and is composed of one or more atoms
mutation	change of the DNA sequence within a gene or chromosome of an organism
mutualism	close, prolonged association between organisms of two different species in which each member benefits; type of symbiotic relationship
natural selection	process by which, in a given environment, individuals having characteristics that aid survival will produce more offspring, so the proportion of individuals having such characteristics will increase with each succeeding generation. Two mechanisms of natural selection include: • gradualism - slow genetic modification (evolution) of a population over long periods of time • punctuated equilibrium - relatively rapid evolution at a speciation event
neutron	uncharged elementary particle that has a mass a little greater than that of the proton and is present in most atomic nuclei
nonliving	objects that don't reproduce, grow, react, or use food
nonstandard units of measure	units of measurement based on everyday items (e.g., hands, feet, pace, candy, potato, paper clip) used as a precursor to learning and using standard units of measurement
mutualism	close, prolonged association between organisms of two different species in which each member benefits
nucleus	**Physical science:** central region of an atom, which contains more than 99% of the atom's mass **Life science:** cellular organelle in eukaryotes that contains most of the genetic material
observation	event that is experienced personally or enhanced through measurement or instruments
openness	mind set that allows a person to consider explanations of a phenomena
organic	of, relating to, or derived from living organisms **Chemistry:** having to do with carbon compounds
organism	living individual, such as a plant, animal, bacterium, protist, or fungus; a body made up of organs, organelles, or other parts that work together to carry on the various processes of life

periodic table	arrangement of the chemical elements by atomic number, starting with hydrogen in the upper left-hand corner and continuing in ascending order from left to right, arranged in columns according to similar chemical properties
pH	numerical measure of the acidity or alkalinity of a chemical solution; the negative of the logarithm of the hydrogen ion concentration
phenotype	physical or visible characteristics of an organism that are determined by its genotype
photosynthesis	chemical process by which chlorophyll-containing plants use light to convert carbon dioxide and water into carbohydrates, releasing oxygen as a byproduct
pitch	aurally perceived property of a sound, especially a musical tone, that is determined by the frequency of the waves producing it; highness or lowness of sound
plane	flat or level surface
plate tectonics	theory that explains the global distribution of geological phenomena such as seismicity, volcanism, continental drift, and mountain building in terms of the formation, destruction, movement, and interaction of the Earth's lithospheric plates; the theory that the earth's crust is broken into fragments (plates) which move in relation to one another, shifting continents, forming new crust, and causing volcanic eruptions
population	group of organisms of the same species living and reproducing in a particular habitat or geographic region
population density	number of organisms per unit area
precipitation	any form of water, such as rain, snow, sleet, or hail, which falls to the Earth's surface
predict	to forecast a future occurrence based on past observations or the extension of an idea
prediction	statement of an expected (future) outcome of a planned test assuming that the hypothesis being tested is correct; to be compared with observed result to test the hypothesis
preservation	to keep in perfect or unaltered condition; maintain unchanged
probability	measure of the likelihood of an event occurring
procedures	series of steps taken to accomplish an end
producer	organisms (e.g., green plants) that produce their own organic compounds from simple precursors (such as carbon dioxide and inorganic nitrogen), many of which are food sources for other organisms
prokaryotic	referring to a cell with no nucleus (e.g., a bacterium)
property	characteristic attribute possessed by all members of a class
propose	to put forward for consideration, discussion, or adoption
proton	stable subatomic particle occurring in all atomic nuclei, with a positive electric charge equal in magnitude to that of an electron
pulley	simple machine consisting of a wheel with a grooved rim in which a pulled rope or chain can run to change the direction of the pull and thereby lift a load
pure science	science for the pursuit of scientific knowledge
qualitative	involving quality or kind

quantitative	involving the measurement of quantity or amount
radiation	**Physical science:** transfer of energy by electromagnetic radiation; process of emitting energy in the form of waves or particles (e.g., visible light, X-rays, alpha and beta radiation). **Life science:** the geographic spreading of a species
recessive	of, relating to, or designating an allele that does not produce a characteristic effect when present with a dominant allele
reflect	to throw or bend back (light, for example) from a surface
refract	to deflect from a straight path undergone by light or other wave in passing obliquely from one medium (e.g., air) into another (e.g., glass) in which its speed is different
reliability	to yield the same or compatible results in different clinical experiments or statistical trials
respiration	physical and chemical processes by which an organism supplies its cells and tissues with the oxygen needed for metabolism and relieves them of the carbon dioxide formed in energy-producing reactions
revolution	orbital motion about a point, especially as distinguished from axial rotation
RNA	(Ribonucleic acid) nucleic acids that contains ribose and uracil as structural components and is associated with the control of cellular chemical activities
rotation	act or process of turning around a center or an axis; the turning of a body part about its long axis as if on a pivot
sedimentary	of or relating to rocks formed by the deposition of sediment
sexual	relating to, produced by, or involving reproduction characterized by the union of male and female gametes
simple investigation	investigation involving a single variable
solid	body of definite shape and volume; not liquid or gaseous
species	class of individuals or objects grouped by virtue of their common attributes and their ability to mate and produce fertile offspring, and assigned a common name; a division subordinate to a genus
spectrophotometer	instrument used to determine the intensity of various wavelengths in a spectrum of light
stimulus	object or event that causes a response
stratus	low-altitude cloud formation consisting of a horizontal layer of clouds
structures	way in which parts are arranged or put together to form a whole; makeup **Life science:** arrangement or formation of the tissues, organs, or other parts of an organism; an organ or other part of an organism
subsystem	component of a system (e.g., a solar system is a subsystem of a galaxy)
symbiotic relationship	close, prolonged association between organisms of two different species that may, but does not necessarily, benefit each member; includes mutualism, commensalisms, and parasitism
system	1. group of body organs that together perform one or more vital functions 2. organized group of devices, parts or factors that together perform a function or drive a process (e.g., weather system, mechanical system)
technology	application of science, especially to industrial or commercial objectives; tools and techniques
temperature	degree of hotness or coldness of a body or environment
theory	collection of statements (conditions, components, claims, postulates, propositions) that when taken together attempt to explain a broad class of related phenomena; inferred explanations for observable phenomena
transient	not regular or permanent
U.S. customary units	measuring system used most often in the United States (e.g., inches, pounds, gallons)

valid	correctly inferred or deduced from a premise
variable	characteristic with values (e.g., numbers, colors, sizes) that differ from one object, event, or situation in a group to the others; e.g., in a group of students, their heights differ, thus "height" is a variable • independent: manipulated variable in an experiment or study whose presence or quantity determines the change in the dependent variable • dependent: observed variable in an experiment or study whose changes are determined by the presence or quantity of one or more independent variables
vector	representation of a quantity having both magnitude and direction, such as velocity or force
velocity	rate of change of position and direction with respect to time
Venn Diagram	representation that uses circles to show relationships between sets
vertebrate	having a backbone or spinal column
viable	capable of living, developing, or germinating under favorable conditions
volume	measure of the capacity of a three-dimensional figure or object, measured in cubic units
voluntary	normally controlled by or subject to individual volition, such as voluntary muscle contractions
weathering	effect of exposure to the action of the elements
wedge	piece of material, such as metal or wood, thick at one edge and tapered to a thin edge at the other for insertion in a narrow crevice, used for splitting, tightening, securing, or levering
wheel and axle	simple machine made up of two coaxial cylindrical objects of different size in which the axle (a small wheel) is attached to the center of a larger wheel; the wheel and axle must move together to be a simple machine; a wheel and axle lifts or moves loads

Processes

analyze	to examine methodically by separating into parts and studying their interrelations
classify	to arrange or organize according to category
compare	to examine in order to note the similarities or differences of
communicate	to convey information about; make known; express oneself in such a way that one is readily and clearly understood
conclusion	statement, or statements, that summarize the extent to which hypotheses have been supported or not supported
evaluate	to examine and judge carefully; appraise
infer	to conclude from evidence or premises
inquiry	A process of exploring the natural or material world that leads to asking questions and making discoveries in the search for new understandings
interpret	to explain the meaning of
justify	to demonstrate or prove to be just, right, or valid
measure	to ascertain the dimensions, quantity, or capacity of
observe	to be or become aware of, through one's senses, and may include qualitative or quantitative data
predict	to forecast a future occurrence based on past observation or the extension of an idea
question	to ask
result	quantity or expression obtained by calculation