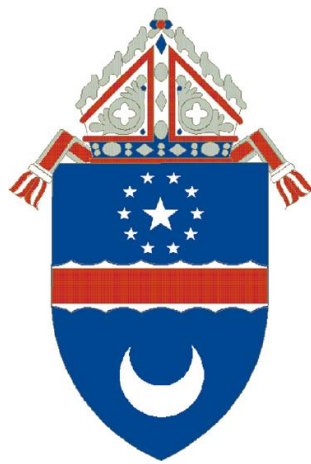


SCIENCE GUIDELINES



DIOCESE OF
ARLINGTON

Revised 2012

SCIENCE GUIDELINES

PHILOSOPHY

God has planted within human nature the desire to know and understand, to learn and explore and to seek the answers to the questions of the world around us. Science is an area of the curriculum where that desire can be fostered by allowing the children to explore and discover the wonders of their world. Science probes the mysteries of the earth and universe, seeking the Creator in all things. Using the Catholic Social Teaching Principles, we must, as educators, create a Christ-centered atmosphere in which the students can and will grow mentally, physically and spiritually.

Our primary goal as science teachers is to facilitate the learning of science by engaging the student through enjoyable and meaningful scientific inquiry, while preparing these students to become life long learners. In this way, the students develop their full potential and grow in the love, knowledge and appreciation of the gift of Life in our World.

Performance Objectives

The following are broad performance objectives to be used when developing lesson plans throughout the year.

1. To cultivate in our students a love, curiosity, respect and stewardship of God's infinite creation.
2. To recognize that we share the responsibility to respect the sanctity of all life and the dignity of the human person.
3. To develop scientific inquiry skills to be used both in individual and cooperative learning environments.
4. To maximize hands-on opportunities for students to explore, discover and experience the universe.
5. To insure the ability of students to safely use scientific materials and equipment to explore, discover and experience the universe.
6. To incorporate mathematical tools into the organization and interpretation of the data.
7. To integrate technology to prepare students to be able to effectively succeed in today's society.
8. To achieve scientific literacy and an understanding of the role science plays in our daily lives through utilization of cross-curricular instruction.

Kindergarten

Scientific Investigation, Reasoning and Logic

S.K.1 The student will conduct investigations in which

- a) basic properties of objects are identified by direct observation
- b) observations are made from multiple positions to achieve different perspectives
- c) a set of objects is sequenced according to size
- d) a set of objects is separated into two groups based on a single physical attribute
- e) picture graphs are constructed using 10 or fewer units
- f) nonstandard units are used to measure (length, mass and volume common objects)
- g) an unseen member in a sequence of objects is predicted
- h) a question is developed and predictions are made from one or more observations
- i) observations are recorded
- j) objects are described both pictorially and verbally
- k) unusual or unexpected results in an activity are recognized

Introduction to Living Things

S.K.2 The student will explore, experience and investigate the senses of sight, hearing, touch, taste and smell. Senses allow the analysis of information in order to learn about one's surroundings.

Concepts include:

- a) sight, hearing, taste, touch and smell
- b) organs associated with each sense
- c) comparative description of sensory experiences (hard, soft, hot, cold, sweet, sour, smooth, etc.)
- d) shapes and forms of objects
- e) relative sizes and weights of objects
- f) relative positions and speed of objects

S.K.3 The student will explore and investigate the basic needs of living things and simple patterns that occur in his/her life.

Concepts include:

- a) living things need food, water and air; non-living things do not
- b) living things have a life cycle with changes that can be measured
- c) parents and offspring are similar

S.K.4 The student will investigate and understand basic needs and life processes of plants and animals .

Concepts include:

- a) animals need adequate food, water, shelter, air and space to survive
- b) plants need nutrients, water air, light and a place to grow to survive
- c) plants and animals change as they grow, have varied life cycles and eventually die
- d) offspring of plants and animals are similar but not identical to their parents or to one another

Earth Science

S.K.5 The student will investigate and understand that there are simple repeating patterns in his/her daily weather observations (describe and chart (visually display) the daily weather conditions.

Concepts include:

- a) common terms such as warm/cool, sunny/cloudy, etc.
- b) relate weather trends to seasonal changes
- c) shapes and forms of many natural objects including seeds, cones and leaves
- d) animal and plant growth

S.K.6 The student will observe and understand that the sun, moon, stars, clouds, birds and airplanes all have properties, locations and movements that can be observed and described.

Concepts include:

- a) shadows occur in nature when sunlight is blocked by an object
- b) shadows can be produced by blocking artificial light

S.K.7 The sun provides the light and heat necessary to maintain the temperature of the earth.

Physical Science

S.K.8 The student will explore the properties of matter.

Concepts include:

- a) colors
- b) textures and feel (smooth, rough, etc.)
- c) relative size and weight of objects
- d) position in space (high/low, behind/ before, thin/wide, etc.) and speed of objects
- e) shapes and forms
- f) compare solids, liquids and gases

S.K.9 The student will investigate and understand that materials can be reused, recycled and conserved.

Concepts include:

- a) materials and objects can be used over and over again
- b) everyday materials can be recycled
- c) water and energy conservation at home and in school helps ensure resources are available for future use

First Grade:

Scientific Investigation, Reasoning and Logic

S.1.1 With teacher guidance, the student will plan and conduct investigations in which

- a) differences in physical properties are observed using the senses and simple instruments to enhance observations (magnifying glass, thermometer, ruler, balance)
- b) observations are made from multiple positions to achieve a variety of perspectives and are repeated to ensure accuracy
- c) length, mass, volume and temperature are measured using standard and nonstandard units
- d) objects or events are classified and arranged according to characteristics or properties
- e) a question is developed from one or more observations
- f) observations and data are communicated orally and with simple graphs, pictures, written statements and numbers
- g) inferences are made and conclusions are drawn about familiar objects and events
- h) predictions are based on patterns of observation rather than random guesses
- i) simple experiments are conducted to answer questions

Physical Science

S.1.2 The student will investigate and develop an understanding that moving objects exhibit different kinds of motion.

Concepts include:

- a) the position of an object can be described by locating it relative to another object or to the background
- b) objects may have straight, circular and back and forth motions
- c) pushes and pulls can change the motion of an object; the change is related to the strength of the motion
- d) objects may vibrate and produce sound; changing the rate of vibration changes the pitch of the sound

Earth Science

S.1.3 The student will explore and investigate the basic relationship of the sun and the earth.

- a) the sun is the source of energy and light that warms the land, air and water
- b) the rotation of the Earth causes night and day
- c) objects in the sky have patterns of movement (sun rises in the east and sets in the west; monthly phases of the moon result in observable changes in its shape)

S.1.4 The student will investigate and understand weather and seasonal changes.

Concepts include:

- a) changes in temperature, light and precipitation affect plants and animals, including humans
- b) there are relationships between daily and seasonal changes
- c) changes in temperature, light and precipitation can be observed and recorded over time

S.1.5 The student will be able to identify and discuss the ways living things affect and

are affected by the environment.

Concepts include:

- a) identification and use of natural resources (renewable and non-renewable)
- b) conservation of resources (recycling, reusing and reducing consumption)
- c) factors that affect the quality of land air and water (pollution)

Life Science

S.1.6 The student will identify and describe the basic needs and structures of plants.

Concepts include:

- a) needs of plants: air, water, light, nutrients and a place to grow
- b) observations of structures: seeds, roots, stems, leaves, flowers
- c) seeds develop into plants, then flowers and then fruits which contain seeds
- d) characteristics of plants: flowering/non-flowering, evergreen/deciduous, edible/non-edible
- e) seasonal changes

S.1.7 The student will identify and describe the basic needs and structures of animals.

Concepts include:

- a) needs of animals: air, nutrients, water, a place to grow (habitat) and shelter
- b) physical characteristics: shape, size, locomotion and appendages
- c) classify animals according to one or more properties
- d) seasonal adaptations (hibernation, camouflage and migration)

S.1.8 The student will be able to identify the basic characteristics and needs of the human body.

Concepts include:

- a) appendages and major organs (heart, lungs, brain and stomach)
- b) nutritional requirements for a healthy active lifestyle (ChooseMyPlate.gov)
- c) hygiene needs: teeth (structure, care, correlation of diet), hand washing
- d) seasonal needs: clothing, shelter

Second Grade

Scientific Investigation, Reasoning and Logic

S.2.1 The student will conduct investigations in which

- a) observation and predictions are made and questions are formed
- b) observations are differentiated from personal interpretation
- c) observations are repeated to ensure accuracy
- d) two or more characteristics or properties are used to classify items
- e) length, volume, mass and temperature measurements are made in metric units (centimeters, meters, liters, degrees Celsius, grams, kilograms) and standard English units (inches, feet, yards, cups, pints, quarts, gallons, degrees Fahrenheit, ounces, pounds)
- f) conditions that influence a change in an experiment are identified
- g) data are collected and recorded
- h) pictures and bar graphs are constructed using numbered axes
- i) conclusions are drawn and communicated
- j) simple physical models are constructed

Physical Science

S.2.2 The student will investigate and understand that objects are made of substances that have physical properties.

Concepts include:

- a) matter is anything that has mass and takes up space
- b) matter has properties that can be observed and measured such as: color, shape, density, hardness, size, texture, smell
- c) objects are made of one or more substances
- d) substances are composed of parts that are too small to see without magnification
- e) physical properties remain the same as the substance is reduced in size

S.2.3 The student will identify and classify the states of matter, and observe the changes from one state to another.

Concepts include:

- a) identification of distinguishing characteristics of solids, liquids and gases
- b) state of matter is related to temperature
- c) evaporation, condensation, melting, boiling, freezing
- d) matter may expand or contract with change of state (example: water expands when frozen)

S.2.4 The student will explore, create and separate mixtures, using common materials, methods and tools.

Concepts include:

- a) interaction of substances with water: food coloring, oil, salt, sugar, sand and gravel
- b) substances dissolve better in warm water than in cold water
- c) some substances change the way water acts (soap, detergent)
- d) mixtures can be separated: gravel and sand or sugar and rice (using a strainer), salt and water (by evaporation), sugar, sand and water (using a filter, then evaporation)

S.2.5 The student will investigate the properties of light.

Concepts include:

- a) sight is not possible without light
- b) light travels in a straight line until it strikes an object
- c) white light can be refracted (bent) into the spectrum by a prism
- d) colors of the visible spectrum are red, orange, yellow, green, blue, indigo and violet
- e) mirrors reflect light

S.2.6 The student will explore and discover the properties of magnets.

Concepts include:

- a) magnets attract some metals (iron and steel) but do not attract non-metals
- b) differently shaped magnets (horseshoe, bar, rod, ring)
- c) some magnets are stronger than others
- d) all magnets have a north and a south pole
- e) like poles repel, unlike attract
- f) compasses and Earth's magnetic field (application)

Earth Science

S.2.7 The student will investigate and understand the basic types, changes and seasonal patterns of weather.

Concepts include:

- a) observing and recording daily weather conditions such as sunny, cloudy, windy, rainy or snowy
- b) using a thermometer to measure and record daily temperatures (metric and standard English units)
- c) observing and describing types of precipitation (rain, snow, sleet and hail)
- d) describing how tracking weather data over time helps scientists make future weather predictions

Life Science

S.2.8 The student will investigate and understand that animals and plants go through a series of changes in their life cycle.

Concepts include:

- a) living things change in an orderly way as they grow
- b) the pattern of change from birth to death is called the life cycle
- c) some animals go through distinct stages in their life cycles while others do not
- d) effects of weather and seasonal changes on the growth and behavior
- e) habitats change over time due to seasonal influences

S.2.9 The student will investigate and understand that living things are part of a system.

Concepts include:

- a) living organisms are interdependent with their living and nonliving surroundings
- b) an animal's habitat includes adequate food, water, shelter or cover and space
- c) plants provide oxygen, homes and food for many animals

Third Grade

Scientific Investigation, Reasoning and Logic

S.3.1 The student will plan and conduct investigations in which

- a) predictions and observations are made
- b) objects with similar characteristics are classified into at least two sets and two subsets
- c) questions are developed to formulate hypotheses
- d) data are gathered, charted, graphed, analyzed and communicated (line plot, picture graph and bar graph)
- e) inferences are made and conclusions are drawn
- f) volume is measured to the nearest milliliter and liter
- g) length is measured to the nearest centimeter
- h) mass is measured to the nearest gram
- i) temperature is measured to the nearest degree Celsius
- j) time is measured to the nearest minute using analog/digital clock
- k) natural events are sequenced chronologically
- l) models are designed and built when relevant

Physical Science

S.3.2 The student will investigate and understand characteristics and interactions of moving objects.

- a) Motion is described by an object's direction and speed;
- b) Forces cause changes in motion;
- c) Friction is a force that opposes motion; and
- d) Moving objects have kinetic energy.

S.3.3 The student will identify simple and compound machines and their uses

Concepts include:

- a) push and pull (forces)
- b) ramps
- c) wedges
- d) levers
- e) screws
- f) wheels and axles
- g) pulleys (fixed and movable)

Earth Science

S.3.4 The student will investigate and understand the water cycle and its relationship to life on Earth.

Concepts include:

- a) there are many sources of water on Earth
- b) the energy of the sun drives the water cycle
- c) the water cycle involves several processes (evaporation, condensation, precipitation)
- d) water is essential for living things
- e) water on Earth is limited and needs to be conserved

S.3.5 The student will investigate and understand the major components of soil, its origin and importance to plants and animals including humans.

Concepts include:

- a) soil provides the support and nutrients necessary for plant growth
- b) topsoil is a natural product of subsoil and bedrock
- c) rock, clay, silt, sand and humus are components of soils
- d) soil is a natural resource and should be conserved

S.3.6 The student will investigate and understand that natural events and human influences can affect the survival of species.

Concepts include:

- a) the interdependency of plants and animals
- b) the effects of human activity on the quality of air, water and habitat
- c) the effects of fire, flood, disease and erosion on organisms
- d) conservation of resources (renewable: sunlight, water, wind; nonrenewable: coal, oil, natural gas, wood)

Life Science

S.3.7 The student will develop an understanding and appreciation of ecosystems and how they function.

Concepts include:

- a) living and non-living components of ecosystems
- b) gathering and storing food
- c) shelter (habitat)
- d) biodiversity
- e) fresh water ecosystems (explore at least one: pond, marshland, swamp, stream, river)
- f) terrestrial ecosystems (explore at least one: desert, grassland, rainforest, forest)

S.3.8 The student will develop an understanding of food chains and food webs.

Concepts include:

- a) sun is the initial source of energy
- b) energy is passed from organism to organism
- c) producers, consumers and decomposers
- d) herbivores, carnivores and omnivores
- e) predator/prey
- f) aquatic and terrestrial food chains
- g) altered food chains and food webs

S.3.9 The student will investigate and understand that adaptations allow animals to satisfy life needs and respond to the environment.

Concepts include:

- a) behavioral adaptations (reflex, instinct, migration, hibernation)
- b) physical adaptations (defense, camouflage)

S.3.10 The student will investigate and understand the processes of basic digestion and elimination.

Concepts include:

- a) organs and function of the digestive system
- b) organs and function of the excretory system

Fourth Grade

Scientific Investigation, Reasoning and Logic

S.4.1 The student will plan and conduct investigations in which

- a) distinctions are made among observations, inferences, predictions and conclusions;
- b) hypotheses are formulated based on cause-and-effect relationships (if-then statement);
- c) constants in an experimental situation are identified;
- d) independent and dependent variables are identified;
- e) appropriate instruments are selected to measure linear distance, volume, mass, temperature and elapsed time;
- f) appropriate metric measures are used to collect, record and report data;
- g) data are collected, recorded, analyzed, and displayed using tables and graphs (bar and line);
- h) numerical data that are contradictory or unusual in experimental results are recognized;
- i) results are communicated verbally, graphically and in writing;
- j) models are designed and built when relevant

Physical Science

S.4.2 The student will investigate and understand the characteristics of electricity

Concepts include:

- a) simple electro magnets and magnetism
- b) static electricity
- c) electrical energy can be transformed into light and motion to produce heat
- d) safety in handling electrical circuits and material
- e) conductors and insulators
- f) parallel and series circuits
- g) construct simple circuits using dry cell batteries
- h) historical contributions in understanding electricity (Benjamin Franklin, Thomas Edison and Alessandro Volta)

Earth Science

S.4.3 The student will investigate and understand how weather conditions and events occur and can be predicted

Concepts include

- a) temperature, air pressure, fronts, humidity
- b) reading and interpreting weather maps
- c) interpreting weather reports
- d) formation and types of clouds
- e) formation of storms (hurricane, tornado, cyclone)
- f) the relation of the position of the earth and sun to seasonal changes
- g) wind direction (direction from which the wind comes)
- h) barometer, thermometer, anemometer, rain gauge, hygrometer

S.4.4 The student will investigate and understand the organization of the solar system. Key concepts include

- a) the planets in the solar system
- b) the order of the planets in the solar system; and
- c) the relative sizes of the planets

S.4.5 The student will investigate and understand the relationships among the earth, the sun and moon.

Concepts include:

- a) the rotation and revolution of Earth, the moon and the sun
- b) causes for Earth's seasons and phases of the moon
- c) the relative size, position, age and makeup of Earth, the moon and the sun
- d) historical contributions to the understanding of the Sun-Moon-Earth system including the work of Copernicus, Galileo and Newton

Life Science

S.4.6 The student will investigate and understand basic plant anatomy and life processes.

Concepts include:

- a) the structure of typical plants (leaves, stems, roots, and flowers) and their functions
- b) processes and structures involved with reproduction (pollination, stamen, pistil, sepal, embryo, spore and seed)
- c) photosynthesis (sunlight, chlorophyll, water, carbon dioxide, oxygen and sugar)
- d) dormancy as a response to the plant's environment

S.4.7 The student will investigate and understand the structure and basic functions of the circulatory system.

Concepts include:

- a) heart, arteries, veins, capillaries and blood
- b) transport of oxygen and carbon dioxide
- c) transport energy (food) and waste
- d) disease control (white blood cells)
- e) bone marrow and red blood cells
- f) the path of circulation

S.4.8 The student will investigate and understand the basic structure and function of the respiratory system.

Concepts include:

- a) nose, pharynx, tracheae, bronchi, lungs and alveoli
- b) exchange of oxygen and carbon dioxide
- c) effects of smoking on the lungs

S.4.9 The student will investigate and understand the basic structure and function of the nervous system

Concepts include:

- a) brain, spinal cord
- b) voluntary muscle control and reflexes
- c) senses
- d) safety issues regarding head injuries (bike helmets, etc.)
- e) effects of drugs on the brain and nervous system

S.4.10 The student will explore and investigate the ecosystems of the ocean

Concepts include:

- a) physical characteristics (depth, salinity, major currents)
- b) geological characteristics (continental shelf, slope rise, trenches, plateau)
- c) biodiversity of plants and animals
- d) plant and animal adaptations within an aquatic environment
- e) organization of populations, communities, habitats and niches
- f) flow of energy through food webs
- g) potential of the oceans as a major resource (food, energy)
- h) influences of human activity on the ocean ecosystem (pollution, overfishing and conservation)

Fifth Grade

Scientific Investigation, Reasoning and Logic

S.5.1 The student will plan and conduct investigations in which

- a) rocks and organisms are identified using various classification keys
- b) estimations of length, mass, volume and temperature are made
- c) appropriate instruments are selected and used for making accurate observations of length, mass, volume, elapsed time and temperature; cells are viewed using microscope
- d) accurate SI measurements are made using basic tools (thermometer, meter stick, balance, graduated cylinder, stopwatch)
- e) constants as well as independent and dependent variables are identified
- f) data are collected, recorded and reported using the appropriate graphical representation (graphs, charts, diagrams)
- g) predictions are made using patterns and simple graphical data are extrapolated
- h) models are constructed to clarify explanations, demonstrate relationships and solve needs
- i) inferences are made and conclusions are drawn
- j) an understanding of the nature of science is developed and reinforced

Physical Science

S.5.2 The student will investigate and understand that matter is anything that takes up space and has mass

Concepts include:

- a) matter has physical and chemical properties that can be measured
- b) atoms are the building blocks of all matter (include proton, neutron, electron, nucleus)
- c) atoms make up molecules
- d) elements, compounds, mixtures including solutions
- e) distinguishing properties of each phase of matter
- f) atoms are always in motion, adding or removing heat will cause atoms to move faster or slower
- g) effect of temperature on state of matter

S.5.3 The student will investigate and understand how sound is transmitted and is used as a means of communication.

Concepts include:

- a) compression/longitudinal waves (rarefaction)
- b) vibration, frequency, pitch, amplitude
- c) the ability of different media (solids, liquids and gases) to transmit sound
- d) uses and applications (voice, sonar, animal sounds and musical instruments)
- e) structure of the ear and mechanics of hearing

S.5.4 The student will investigate and understand basic characteristics of visible light

Concepts include:

- a) the visible spectrum and light waves (transverse)
- b) opaque, transparent and translucent

- c) refraction of light through water and prisms
- d) reflection of light from reflective surfaces (mirrors)
- e) structure of the eye and mechanics of sight

Earth Science

S.5.5 The student will investigate and understand how Earth's surface is constantly changing.

Concepts include:

- a) surface layers include lithosphere, hydrosphere, atmosphere
- b) Earth's structure consisting of a crust (including the ocean floor), mantle and core
- c) plate tectonic theory explains the movement of the Earth's crust
- d) earthquakes and volcanoes, as well as how they might be predicted
- e) surface changes are caused by weathering, erosion and deposition
- f) weathering may be physical or chemical
- g) natural agents of change are water (running water, groundwater, waves, glaciers) and wind
- h) geological changes may be sudden or gradual
- i) Earth's landscape includes mountains, valleys, caves, glaciers, floodplains, deltas and sand dunes
- j) rocks are classified by how they are formed; the rock cycle
- k) geological history, topics include fossils, carbon dating
- l) human impact on the physical features of the Earth

Life Science

S.5.6 The student will identify life processes for all living organisms.

Concepts include:

- a) getting energy
- b) using energy
- c) getting rid of waste including respiration
- d) reproducing
- e) growing and developing
- f) reacting to change

S.5.7 The student will identify the major characteristics of living things.

Concepts include:

- a) cell is the smallest unit of a living thing, basic cell structures and functions
- b) introduction to the three domains (Archaea, Eubacteria, Eukaryota) and the six kingdoms based on cell structure, energy source
- c) plant and animal cells have similar and different parts
- d) cells, tissues and organs work together as a system

S.5.8 The student will investigate and recognize animals as either vertebrates or invertebrates.

Concepts include:

- a) Invertebrates are animals without backbones
- b) Vertebrates are animals with backbones and internal skeletons

S.5.9 The student will investigate and understand the structures and functions of the internal skeletal system and muscular system of the human body.

Concepts include:

- a) skeletal system's primary functions include provides shape and support, protects internal organs, works with muscular system to move
- b) cartilage, ligaments, tendons and joints (ball and socket, hinge and pivot)
- c) voluntary, involuntary and cardiac muscle
- d) nutrients, exercise and rest are needed to keep the skeletal and muscular systems healthy
- e) drugs are chemicals that can cause a change in almost any part of the body

S.5.10 The student will identify plants as being vascular or non-vascular

Concepts include:

- a) simple plants (mosses) have no vessels
- b) vascular plants include ferns that produce spores and seed plants that are either flowering or non-flowering
- c) transpiration is the passage of water through a plant

Sixth Grade

Scientific Investigation, Reasoning and Logic

S.6.1 The student will plan and conduct investigations in which

- a) observations are made involving fine discrimination between similar objects and organisms;
- b) precise and approximate measurements are recorded;
- c) scale models are used to estimate distance, volume and quantity;
- d) hypotheses are stated in ways that identify the independent (manipulated) and dependent (responding) variables;
- e) a method is devised to test the validity of predictions and inferences;
- f) data are collected, recorded, analyzed and reported using appropriate metric measurements;
- g) data are organized and communicated through graphical representation (graphs, charts and diagrams);
- h) models are designed to explain a sequence;
- i) an understanding of the nature of science is developed and current applications are used to reinforce science concepts; and
- j) one variable is manipulated over time, using many repeated trials.

Environmental Science

S.6.2 The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere and on the Earth's surface.

Concepts include:

- a) Earth's energy budget (total power entering and leaving the physical system of Earth);
- b) the role of radiation and convection in the distribution of Earth's energy;
- c) the motion of the atmosphere and the oceans;
- d) cloud formation; and
- e) the role of thermal energy in weather-related phenomena including thunderstorms and hurricanes.

S.6.3 The student will investigate and understand the properties of air and the structure and dynamics of Earth's atmosphere.

Concepts include:

- a) air as a mixture of gaseous elements and compounds;
- b) air pressure, temperature and humidity;
- c) how the atmosphere changes with altitude;
- d) natural and human-caused changes to the atmosphere;
- e) the relationship of atmospheric measures and weather conditions;
- f) basic information from weather maps including fronts, systems and basic measurements; and
- g) the importance of protecting and maintaining air quality.

S.6.4 The students will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment.

Concepts include:

- a) water as the universal solvent;
- b) the properties of water in all three states;
- c) the action of water in physical and chemical weathering;
- d) the ability of large bodies of water to store heat and moderate climate;
- e) the importance of water for agriculture, power generation and public health; and
- f) the importance of protecting and maintaining water resources.

S.6.5 The student will investigate and understand the natural processes and human interactions that affect watershed systems.

Concepts include:

- a) the health of ecosystems and the abiotic factors of a watershed;
- b) the location and structure of Virginia's regional watershed systems;
- c) divides, tributaries, river systems and river and stream processes;
- d) wetlands;
- e) estuaries;
- f) major conservation, health, and safety issues associated with watersheds; and
- g) water monitoring and analysis using field equipment including hand-held technology.

S.6.6 The student will investigate and understand environmental issues.

Concepts include:

- a) management of renewable resources (water, air, soil, plant life, animal life);
- b) management of nonrenewable resources (coal, oil, natural gas, nuclear power, mineral resources);
- c) the mitigation of land-use and environmental hazards through preventive measures; and
- d) cost/benefit tradeoffs in conservation policies.

Physical Science

S.6.7 The student will understand that all matter is made up of atoms.

Concepts include:

- a) atoms are made up of electrons, protons and neutrons;
- b) atoms of any element are alike but are different from atoms of other elements;
- c) elements may be represented by chemical symbols;
- d) two or more atoms may be chemically combined;
- e) compounds may be represented by chemical formulas;
- f) chemical equations can be used to model chemical changes; and
- g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans and the atmosphere.

S.6.8 The student will understand that energy is a property of many substances. The student will investigate and understand basic sources of energy, their origins, transformations, and uses.

Concepts include:

- a) potential and kinetic energy;

- b) energy can take many forms including, thermal, light, electrical, mechanical motion, sound, nuclear and chemical;
- c) energy transformations (heat/light to mechanical, chemical and electrical energy);
- d) the role of the sun in the formation of most energy sources on Earth;
- e) nonrenewable energy sources (fossil fuels including petroleum, natural gas and coal); and
- f) renewable energy sources (wood, wind, hydro, geothermal, tidal and solar).

Life Science

S.6.9 The student will investigate and understand interactions in a biological community.

Concepts include:

- a) the relationships among producers, consumers and decomposers in food webs;
- b) the relationship between predators and prey;
- c) energy flow in food webs and energy pyramids;
- d) competition, cooperation, social hierarchy and territorial imperative within a population;
- e) symbiotic relationships; and
- f) niches.

S.6.10 The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem.

Concepts include:

- a) differences between ecosystems and biomes;
- b) characteristics of land, freshwater and marine ecosystems;
- c) adaptations that enable organisms to survive within a specific ecosystem;
- d) complex relationships within land, freshwater and marine ecosystems; and
- e) the carbon, water and nitrogen cycles.

S.6.11 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and respond to daily, seasonal and long-term changes in their environment.

Concepts include:

- a) phototropism, hibernation and dormancy;
- b) factors that increase or decrease population size; and
- c) eutrophication, climate changes and catastrophic disturbances.

S.6.12 The student will investigate and understand the relationships between ecosystem dynamics and human activity.

Concepts include:

- a) food production and harvest;
- b) change in habitat size, quality or structure;
- c) change in species competition;
- d) population disturbances and factors that threaten or enhance species survival; and
- e) review of environmental issues (water supply, air quality, energy production and waste management).

Earth Space Systems

S.6.13 The student will review the organization of the solar system and the relationships among the various bodies that comprise it.

Concepts include:

- a) the sun, moon, Earth, other planets and their moons, meteors, dwarf planets, asteroids and comets;
- b) relative size of and distance between planets;
- c) the role of gravity;
- d) revolution and rotation;
- e) the mechanics of day and night and the phases of the moon;
- f) the unique properties of Earth as a planet;
- g) the relationship of the Earth's tilt and the seasons;
- h) the cause of tides; and
- i) the history and technology of space exploration.

Seventh Grade

Scientific Reasoning, Investigation and Logic

S.7.1 The student will plan and conduct investigations in which

- a) data are organized into tables showing repeated trials and means;
- b) variables are defined;
- c) metric units (SI—International System of Units) are used;
- d) models are constructed to illustrate and explain phenomena;
- e) sources of experimental error are identified;
- f) dependent variables, independent variables and constants are identified;
- g) variables are controlled to test hypotheses and trials are repeated;
- h) continuous line graphs are constructed, interpreted and used to make predictions;
- i) interpretations from a set of data are evaluated and defended;
- j) an understanding of the nature of science is developed and current applications are used to reinforce life science concepts;
- k) a classification system is developed based on multiple attributes; and
- l) instruments, such as simple compound light microscopes, triple beam and electronic balances, thermometers, metric rulers, graduated cylinders and probeware are used to make observations and measurements.

S.7.2 The student will demonstrate the ability to select design and implement an independent research project by participating in a Science Fair or national contest or in a competition requiring independent scientific research.

Life Science

S.7.3 The student will define and discuss the basic theories of the origin of life.

Concepts include:

- a) spontaneous generation and the disproof of this theory and
- b) biogenesis and the proof of this theory

S.7.4 The student will define and explain the life processes and needs.

Concepts include:

- a) use of energy
- b) growth and development
- c) ability to adapt
- d) respiration
- e) reproduction
- f) response to stimuli

S.7.5 The student will investigate and understand that all living things are composed of cells.

Concepts include:

- a) cell structure and organelles;
- b) similarities and differences between plant and animal cells;
- c) development of cell theory;
- d) cell division – mitosis and meiosis;
- e) construct a cell model; and

- f) living things show patterns of cellular organization: cells, tissues, organs and systems.

S.7.6 The student will investigate and understand cell functions and processes.

Concepts include:

- a) movement of materials across cell membranes, including: passive and active transport, osmosis and selective permeability;
- b) the basic physical and chemical processes of photosynthesis and its importance to plant and animal life, including energy transfer between sunlight and chlorophyll, transformation of water and carbon dioxide into sugar and oxygen; and photosynthesis as the foundation of virtually all food webs;
- c) cellular respiration; and
- d) an introduction to organic compounds including: carbohydrates, lipids and proteins.

S.7.7 The student will investigate and understand that organisms reproduce and transmit genetic information to new generations.

Concepts include:

- a) historical contributions and significant discoveries related to genetics (for example, Rosalind Franklin, Watson, and Crick and Gregor Mendel);
- b) structure and role of DNA;
- c) function of genes and chromosomes;
- d) dominant and recessive traits;
- e) genotypes and phenotypes;
- f) Punnett squares;
- g) characteristics that can and cannot be inherited; and
- h) genetic engineering and its applications such as disease therapy and agriculture (enrichment).

S.7.8 The student will investigate and understand that populations of organisms change over time.

Concepts include:

- a) the relationships of mutation, adaptation, natural selection and extinction;
- b) evidence of evolution of different species in the fossil record; and
- c) how environmental influences, as well as genetic variation, can lead to diversity of organisms.

S.7.9 The student will define, classify and describe the **basic** characteristics of the Domains and Kingdoms of living organisms. Basic characteristics include 1) number of cells in the organism, 2) method of obtaining food, 3) whether or not they move, 4) the presence or absence of a nucleus in their cells.

Concepts may include:

- a) the distinguishing characteristics of domains of organisms (Archaea, Eubacteria, Eukaryotes);
- b) the distinguishing characteristics of kingdoms of organisms; (Archaeobacteria, Eubacteria, Protists, Fungi, Plants, Animals);
- c) the basic characteristics of major animal phyla (cnidarians, annelids, arthropods, echinoderms, mollusks and chordates) and plant divisions (mosses, ferns, conifers, angiosperms);
- d) the characteristics that define a species;
- e) dichotomous key;
- f) binomial nomenclature; and
- g) viruses.

S.7.10 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment.

Concepts include:

- a) the carbon, water and nitrogen cycles;
- b) interactions resulting in a flow of energy and matter throughout the system;
- c) complex relationships within terrestrial, freshwater and marine ecosystems; and
- d) energy flow in food webs and energy pyramids.

S.7.11 The student will investigate and understand that interactions exist among members of a population.

Concepts include:

- a) competition, cooperation, social hierarchy, territorial imperative and
- b) influence of behavior on a population.

S.7.12 The student will identify the major organs and systems of the human body.

Concepts include:

- a) respiratory;
- b) nervous;
- c) excretory;
- d) musculoskeletal;
- e) circulatory;
- f) digestive; and
- g) endocrine.

S.7.13 The student will define and explain the process of growth and development and life span of the human.

Concepts include:

- a) neonate, infant, childhood, adolescence and adult and
- b) behavioral and developmental expectations.

S.7.14 The student will understand the process of reproduction of the human. This unit could be integrated with, or taught as, the Family Life Unit of Religion. Be **SURE** to check your school policy prior to instructing this objective. Refer to the Formation of Christian Chastity policy.

Eighth Grade:

Scientific Investigation, Reasoning and Logic

S.8.1 The student will plan and conduct investigations in which

- a) chemicals and equipment are used safely;
- b) length, mass, volume, density, temperature, weight and force are accurately measured and reported using metric units (SI—International System of Units);
- c) conversions are made among metric units, applying appropriate prefixes;
- d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders and spring scales are used to gather data;
- e) numbers are expressed in scientific notation where appropriate;
- f) research skills are utilized using a variety of resources;
- g) independent and dependent variables, constants, controls and repeated trials are identified;
- h) data tables showing the independent and dependent variables, derived quantities and the number of trials are constructed and interpreted;
- i) data tables for descriptive statistics showing specific measures of central tendency, the range of the data set and the number of repeated trials are constructed and interpreted;
- j) frequency distributions, scattergrams, line plots and histograms are constructed and interpreted;
- k) valid conclusions are made after analyzing data;
- l) research methods are used to investigate practical problems and questions;
- m) experimental results are presented in appropriate written form;
- n) models and simulations are constructed and used to illustrate and explain phenomena; and
- o) an understanding of the nature of science is developed and current applications of physical science are used to reinforce concepts.

S.8.2 The student will demonstrate the ability to select, design and implement an independent research project by participating in a Science Fair or national contest or competition requiring independent scientific research.

Chemistry

S.8.3 The student will investigate and identify the characteristics of matter.

Concepts include:

- a) solid, liquid, gas, plasma;
- b) elements, compounds and mixtures (solutions, suspensions and colloids);
- c) organic and inorganic;
- d) acids, bases and salts;
- e) physical properties: shape, density, color, odor, boiling point, melting point, solubility and miscibility; and
- f) chemical properties: acidity, basicity, pH, combustibility, reactivity.

S.8.4 The student will investigate and explain the history of atomic theory and the structures of the atom.

Concepts include:

- a) the historical development of atomic theory (including Dalton, Thomson, Rutherford and Bohr);
- b) Bohr model and electron cloud model (modern model of the atom);
- c) nucleus, proton, neutrons, electrons;
- d) ions; and
- e) isotopes.

S.8.5 The student will obtain and explain information from the Periodic Table of Elements.

Concepts include:

- a) symbol, atomic number and atomic mass;
- b) metals, non-metals, metalloids and noble gases;
- c) chemical families (groups) and periods;
- d) oxidation number; and
- e) synthetic elements.

S.8.6 The student will analyze the Periodic Table of Elements and will develop correct inferences regarding elements and binary compounds.

Concepts include:

- a) formation of compounds through ionic and covalent bonding;
- b) formulas for compounds; and
- c) names of compounds.

S.8.7 The student will investigate and explain chemical changes of matter using the theory of conservation of matter and energy.

Concepts include:

- a) evidence of reaction
- b) reactants and products
- c) types of reactions
- d) balanced chemical equations

S.8.8 The student will investigate and understand temperature scales, heat and thermal energy transfer and its relation to the kinetic theory.

Concepts include:

- a) Celsius and Kelvin temperature scales and absolute zero;
- b) phase change, freezing point, melting point, boiling point, vaporization and condensation;
- c) conduction, convection and radiation; and
- d) applications of thermal energy transfer.

S.8.9 The student will research and discuss nuclear changes in matter using the theory of conservation of matter and energy.

Concepts include:

- a) fusion and fission;
- b) products of nuclear reactions;
- c) effects on humans and the environment; and
- d) alternative energy sources.

Motion and Force

S.8.10 The student will investigate and understand the scientific principles of motion and the forces that affect it.

Concepts include:

- a) speed, velocity and acceleration;
- b) net force;
- c) friction;
- d) gravity and centripetal force;
- e) Newton's laws of motion; and
- f) deriving SI unit for force (enrichment).

S.8.11 The student will define and explain work

Concepts include

- a) work;
- b) power;
- c) mechanical advantage and efficiency;
- d) simple machines and complex machines; and
- e) deriving SI unit for work (enrichment).

Energy

S.8.12 The student will investigate and understand basic principles of electricity and magnetism.

Concepts include:

- a) static electricity, current electricity and circuits;
- b) relationship between a magnetic field and an electric current;
- c) electromagnets, motors and generators and their uses; and
- d) conductors, semiconductors and insulators.

S.8.13 The student will investigate and explain the basic characteristics of transverse waves

Concepts include:

- a) wavelength, frequency, speed, amplitude, crest and trough;
- b) the wave behavior of light;
- c) images formed by lenses and mirrors;
- d) the electromagnetic spectrum; and
- e) technological applications of light.

S.8.14 The student will investigate and explain the basic characteristics of sound waves

Concepts include:

- a) wavelength, frequency, speed, amplitude, rarefaction and compression;
- b) resonance;
- c) the nature of compression waves; and
- d) technological applications of sound.