

Virginia Science Standards of Learning - High School Level

Life Science

LS.1 The student will plan and conduct investigations in which: data are organized into tables showing repeated trials and means; variables are defined; SI (metric) units are used; criteria are established for evaluating a prediction; models are constructed to illustrate and explain phenomena; sources of experimental error are identified; dependent variables, independent variables, and constants are identified; variables are controlled to test hypotheses and trials are repeated; continuous line graphs are constructed, interpreted, and used to make predictions; and interpretations from the same set of data are evaluated and defended.

- ST 100/30 Interprets data from a graph relating to energy costs.
- ST 100/30 Interprets data from text relating to energy sources.
- ST 100/30 Extracts data from tables of the origin of pollutant gases.
- ST 100/30 Makes informed decisions based on both given and researched information.
- ST 100/30 Converts hp into Watts using a units conversion table.
- ST 100/30 Identifies trends using a table of tangent values.
- ST 100/30 Predicts shadow length at a particular time of day, using a table of values.
- ST 100/30 Solves hydro electric power problems using worked examples.
- ST 100/30 Evaluates the environmental impact of three potential dam sites.
- ST 100/30 Identifies the effect of population size on the cost effectiveness of forms of energy.
- ST 100/30 Selects heat resistivity (R) values of materials from a table.
- ST 100/30 Compares the insulating properties of single and double glazing.
- ST 110/30 Describes conventions for quantifying weather phenomena.
- ST 150/30 Recognizes SI units.
- ST 190/30 Defines SI units of length.
- ST 190/30 Uses a conversion table to convert SI units into imperial equivalents.

LS.3 The student will investigate and understand that living things show patterns of cellular organization. Key concepts include: cells, tissues, organs, and systems; and functions and processes of cells, tissues, organs, and systems (respiration, removal of wastes, growth, reproduction, digestion, and cellular transport).

- ST 170/30 Plots data on the growth rates of children in the form of a graph.
- ST 170/30 Calculates percentage weight losses from growth charts.
- ST 170/30 Interprets growth charts, showing the weight loss effects of childhood diseases.
- ST 170/30 Describes the immune response system.
- ST 170/30 Compares the mechanisms of two asthma drug delivery systems.
- ST 170/30 Uses computer software to examine the physiology of the urinary system.
- ST 170/30 Measures temperature, pulse and respiration rates.
- ST 170/30 Sets up a datalogging system to monitor cardiac activity.
- ST 170/30 Identifies the blood vessels of the cardiovascular system.
- ST 170/30 Investigate the exchange of blood gases in the circulatory system.
- ST 170/30 Uses a data logging system to monitor cardiac activity.
- ST 170/30 Uses software models to describe the function of the cardiovascular system.
- ST 170/30 Explains how to monitor vital signs using a datalogging system.
- ST 170/30 Evaluates function and treatment of the renal system.

Physical Science

PS.8 The student will investigate and understand characteristics of sound and technological applications of sound waves. Key concepts include: wave length, frequency, amplitude, interference; and technological applications of sound.

- ST 200/30 Identifies wavelength, frequency, and amplitude properties of electromagnetic waves.
- ST 200/30 Quantifies wavelength, frequency, and amplitude properties of electromagnetic waves.
- ST 200/30 Investigates the wavelength of a microwave.
- ST 200/30 Defines the terms amplitude, frequency, range, wavelength and bandwidth.
- ST 200/30 Describes relationships between the values amplitude, frequency, range, wavelength and bandwidth.
- ST 210/30 Identifies the amplitude of a sound wave at given locations.
- ST 210/30 Identifies the location within a sound wave when a particular amplitude occurs.
- ST 210/30 Calculates magnitude of amplification of a sound wave.
- ST 210/30 Obtains information from a graph of a sound wave.
- ST 210/30 Calculates number of samples at a given frequency.
- ST 210/30 Locates amplitude and time readings from a sound wave graph.

PS.9 The student will investigate and understand the nature and technological applications of light. Key concepts include: reflection, refraction, particle theory, wave theory; and electromagnetic spectrum.

- ST 100/30 States the effect of the angle of light on the area lit.
- ST 100/30 Calculates how long it takes light to travel the circumference of the Earth.
- ST 110/30 Describes the characteristics of visible light images.
- ST 140/30 Constructs a light sequencer circuit.
- ST 150/30 States the functions and properties of light and sound sensors when used as system inputs.
- ST 120/30 Connects and monitors a light sensor using a computer.
- ST 120/30 Controls lights and blinds using a light sensor and computer.
- ST 120/30 Programs and connects a computerized light level controller.
- ST 120/30 Programs and tests a program to control lights, blinds and alarms by time.
- ST 210/30 Creates a variety of different light conditions using a camcorder light.
- ST 210/30 Applies camera exposure and backlight controls to investigate the cameras perception of light.

PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include: static, current, circuits; and magnetic fields and electromagnets.

- ST 120/30 Determines the correct wire gauge for circuits in a residential electrical system.
- ST 140/30 Investigates the operation of series connected switch circuits.
- ST 140/30 Investigates the operation of parallel connected switch circuits.
- ST 140/30 Interprets electrical current flow theory from written text.
- ST 140/30 Explains magnetic phenomenon.
- ST 140/30 Describes the operation of an electromagnetic relay.
- ST 140/30 Comprehends historic information on the discovery of magnetism.
- ST 140/30 Constructs an electromagnetic relay circuit.
- ST 140/30 Measures voltage and current in a circuit.
- ST 140/30 Defines electric current.
- ST 140/30 Explains that current flow is controlled by circuit components.
- ST 140/30 States the electromagnetic induction principle for generating electricity.
- ST 140/30 Demonstrates how to generate electricity.

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| ST 140/30 | Compares series and parallel circuits. |
| ST 140/30 | States voltage, current and resistance properties. |
| ST 140/30 | Explains magnetic and electromagnetic principles. |
| ST 140/30 | Solves math problems in Basic Electricity. |
| ST 140/30 | Writes a report on Basic Electricity. |
| ST 140/30 | Makes a presentation to a group on Basic Electricity. |
| ST 170/30 | Recognizes the properties of X-Rays as electromagnetic waves. |

Earth Science

ES.3 The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery. Key concepts include: maps (bathymetric, geologic, topographic, and weather) and star charts; imagery (aerial photography and satellite images); direction and distance measurements on any map or globe; and location by latitude and longitude and topographic profiles.

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| ST 110/30 | Identifies how computer software is used to enhance satellite images. |
| ST 110/30 | Extracts wind speed and direction information from a weather map. |
| ST 110/30 | Describes conventions used for representing areas of air pressure on a weather map. |
| ST 110/30 | Receives and views satellite images. |
| ST 110/30 | Identifies a satellite image from a string of identification characters. |
| ST 110/30 | Applies software to convert infrared information into color coded temperature maps. |
| ST 110/30 | Makes a computer model of clouds in three dimensions. |
| ST 110/30 | Applies weather front symbols to a weather map. |
| ST 110/30 | Extracts forecast information from a weather map. |
| ST 110/30 | Adds weather symbols to satellite image. |
| ST 110/30 | Interprets a contour map and issues a warning to sites at risk from flood. |
| ST 110/30 | Extracts information from a precipitation distribution map of the map U.S. |
| ST 110/30 | Uses satellite software to record animated weather images. |
| ST 120/30 | Interprets a contour map to produce a cross-section of a construction site. |

ES.7 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include: fossil fuels, minerals, rocks, water, and vegetation; advantages and disadvantages of various energy sources; resources found in Virginia; use of resources and their effects on standards of living; and environmental costs and benefits.

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| ST 100/30 | Identifies the energy sources in use today. |
| ST 100/30 | Identifies the operating parameters of a fossil fuel powered generating station. |
| ST 100/30 | Interprets data from text relating to energy sources. |
| ST 100/30 | Interprets information to relate mass of water and applied force. |
| ST 100/30 | Solves hydro electric power problems using worked examples. |
| ST 100/30 | Calculates the power output of a hydro-electric power plant. |
| ST 100/30 | Describes the environmental impact of a hydro-electric power scheme. |
| ST 100/30 | Evaluates the environmental impact of three potential dam sites. |
| ST 100/30 | Predicts environmental problems caused by a hydro electric power station. |
| ST 100/30 | Identifies locations where it would be suitable to use renewable energy sources. |
| ST 100/30 | Completes an Environmental Impact Assessment table. |
| ST 100/30 | Explains how modern water power is obtained. |
| ST 100/30 | Describes how some alternative energy sources are more suitable than others. |
| ST 100/30 | Explains how water power is obtained. |
| ST 110/30 | Describes the properties of water. |
| ST 110/30 | Identifies the trigger to a phase change in water. |
| ST 120/30 | Identifies the resources used in construction technology. |

- ST 120/30 Identifies the products and resources of construction technology.
- ST 150/30 States the definition of energy and the type of energy sources used in transportation systems.

ES.13 The student will investigate and understand that energy transfer between the sun, Earth, and the Earth's atmosphere drives weather and climate on Earth. Key concepts include: observation and collection of weather data; prediction of weather patterns; and weather phenomena and the factors that affect climate.

- ST 110/30 Describes conventions for quantifying weather phenomena.
- ST 110/30 Identifies equipment connected to the weather monitor console.
- ST 110/30 Describes factors that drive weather systems.
- ST 110/30 Extracts wind speed and direction information from a weather map.
- ST 110/30 Describes conventions used for representing areas of air pressure on a weather map.
- ST 110/30 Plots graphs of weather data.
- ST 110/30 Extracts temperature information from a graph of weather data.
- ST 110/30 Describes the use of satellites to monitor the weather.
- ST 110/30 Identifies key characteristics of weather satellites.
- ST 110/30 Identifies weather front symbols.
- ST 110/30 Applies weather front symbols to a weather map.
- ST 110/30 Extracts forecast information from a weather map.
- ST 110/30 Adds weather symbols to satellite image.
- ST 110/30 Uses a weather database to calculate total rainfall.
- ST 110/30 Describes characteristics of the Earth's climate.
- ST 110/30 Classifies areas of the Earth into climate types.
- ST 110/30 Describes main issues affecting the Earth's climate.
- ST 110/30 Defines climate characteristics for a vacation resort.
- ST 110/30 Describes the technology used to make a TV weather forecast.
- ST 110/30 Describes contributory factors towards weather trends.
- ST 110/30 Identifies trends from recorded weather data.
- ST 110/30 Uses satellite software to record animated weather images.
- ST 110/30 Predicts weather conditions for cities in the path of a hurricane.
- ST 110/30 Uses the correct weather symbols and values on a forecast.
- ST 110/30 Places weather symbols in the correct geographic location.
- ST 110/30 Places weather symbols in the correct geographic location.
- ST 110/30 Completes several graphics for a simulated TV weather forecast.

Chemistry

CH.5 The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include: pressure, temperature, and volume; vapor pressure; partial pressures; phase changes; molar heats of fusion and vaporization; specific heat capacity; solutions; and colligative properties.

- ST 100/30 Calculates the potential energy and kinetic energy of a model rocket.
- ST 100/30 Plots a graph of temperature against time to compare single and double glazing.
- ST 110/30 Defines air pressure.
- ST 110/30 Describes conventions used for representing areas of air pressure on a weather map.
- ST 110/30 Plots a graph comparing internal and external temperature.
- ST 110/30 Identifies the trigger to a phase change in water.
- ST 120/30 Calculates the volume of soil to be excavated to level a construction site.
- ST 120/30 Calculates volume and surface area of a geodesic dome.

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| ST 160/30 | Uses a pulse rate monitor to record pulse rate and blood pressure. |
| ST 160/30 | Recognizes the difference between systolic and diastolic blood pressure. |
| ST 170/30 | Measures temperature, pulse and respiration rates. |
| ST 170/30 | Records cardiac activity in order to calculate stroke volume using a software model. |
| ST 170/30 | Calculates cardiac stroke volume using subtraction. |
| ST 180/30 | Distinguishes between static and dynamic pressure. |
| ST 180/30 | Identifies the effects of pressure and pressure changes. |
| ST 180/30 | Solves static and dynamic pressure problems using the Bernoulli equation. |
| ST 190/30 | Calculates kinetic energy of rockets. |
| ST 270/30 | Recognizes pressure as a measurement of force in fluids. |
| ST 270/30 | Identifies the relationship between the pressure and volume in a gas. |
| ST 270/30 | Solves force, pressure, area problems. |
| ST 270/30 | Uses the International System of units to calculate volume. |
| ST 270/30 | Investigates the concept of pressure. |
| ST 280/30 | Defines pressure as force per unit of area. |
| ST 280/30 | Investigates the control of pressure. |
| ST 280/30 | Investigates the measurement of pressure. |
| ST 280/30 | Evaluates pump performance and volumetric efficiency. |
| ST 280/30 | Examines how stroke time is related to bore size and pressure. |

CH.6 The student will investigate and understand how basic chemical principles relate to other areas of chemistry. Key concepts include: organic and biochemistry; nuclear chemistry; and environmental chemistry.

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| ST 100/30 | Identifies the operating parameters of a nuclear powered generating station. |
| ST 100/30 | Describes the environmental impact of a hydro-electric power scheme. |
| ST 100/30 | Evaluates the environmental impact of three potential dam sites. |
| ST 100/30 | Predicts environmental problems caused by a hydro electric power station. |
| ST 100/30 | Describes the processes involved in nuclear fission. |
| ST 100/30 | Identifies the risks and problems of dealing with the waste products of nuclear power stations. |
| ST 100/30 | States the acceptable radiation limits of low level nuclear waste. |
| ST 100/30 | Describes the function of the major parts of a nuclear power plant. |
| ST 100/30 | Describes the operation of a nuclear power plant. |
| ST 100/30 | Completes an Environmental Impact Assessment table. |
| ST 100/30 | States the principles behind nuclear power. |
| ST 240/30 | Uses software to write a control program to automatically load a simulated nuclear reactor with fuel rods. |
| ST 240/30 | Uses software to write a control program to simulate a nuclear reactor fuel rod cycle program. |

Physics

PH.6 The student will investigate and understand that quantities including mass, energy, momentum, and charge are conserved. Key concepts include: kinetic and potential energy; elastic and inelastic collisions; and electric power and circuit design.

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| ST 100/30 | Identifies the energy sources in use today. |
| ST 100/30 | Interprets data from a graph relating to energy costs. |
| ST 100/30 | Interprets data from text relating to energy sources. |
| ST 100/30 | States why the world needs alternative energy. |
| ST 100/30 | Solves problems with units of energy. |

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| ST 100/30 | Calculates the potential energy and kinetic energy of a model rocket. |
| ST 100/30 | Interprets information to relate mass of water and applied force. |
| ST 100/30 | States the alternative energy options available to solve the energy problems facing society today. |
| ST 100/30 | Identifies locations where it would be suitable to use renewable energy sources. |
| ST 100/30 | Identifies the effect of population size on the cost effectiveness of forms of energy. |
| ST 100/30 | States how heat can be conserved in energy production. |
| ST 100/30 | Identifies the problem of cost in trying to conserve energy. |
| ST 100/30 | States the difference in energy consumption by the industrialized and developing countries. |
| ST 100/30 | Determines the total cost of installing energy efficient devices. |
| ST 100/30 | Calculates value of power saved by an energy efficient house. |
| ST 100/30 | Compares energy, work and power. |
| ST 100/30 | Describes the methods by which energy transformation can be measured. |
| ST 100/30 | Explains why energy conservation is important. |
| ST 100/30 | Describes how some alternative energy sources are more suitable than others. |
| ST 100/30 | Writes a report on Alternative Energy. |
| ST 100/30 | Makes a presentation to a group on Alternative Energy. |
| ST 140/30 | Investigates charge storage ability of a capacitor and the battery. |
| ST 140/30 | Quotes charge storage characteristics of a capacitor. |

PH.9 The student will investigate and understand how to use models of transverse and longitudinal waves to interpret wave phenomena. Key concepts include: wave characteristics (period, wavelength, frequency, amplitude and phase); fundamental wave processes (reflection, refraction, diffraction, interference, standing waves, polarization, Doppler effect); and light and sound in terms of wave models.

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| ST 200/30 | Identifies the components used to create a transverse wave. |
| ST 200/30 | Identifies wavelength, frequency, and amplitude properties of electromagnetic waves. |
| ST 200/30 | Quantifies wavelength, frequency, and amplitude properties of electromagnetic waves. |
| ST 200/30 | Investigates the wavelength of a microwave. |
| ST 200/30 | Identifies the relationship between the frequency and bandwidth properties of electromagnetic waves. |
| ST 200/30 | Investigates the concept of microwave polarization, used in satellite television systems. |
| ST 200/30 | Performs an experiment to investigate the reflection of microwaves on different materials. |
| ST 200/30 | Investigates the microwave penetration and reflection with various composite materials. |
| ST 200/30 | Defines the terms amplitude, frequency, range, wavelength and bandwidth. |
| ST 200/30 | Describes relationships between the values amplitude, frequency, range, wavelength and bandwidth. |
| ST 210/30 | Identifies the amplitude of a sound wave at given locations. |
| ST 210/30 | Identifies the location within a sound wave when a particular amplitude occurs. |
| ST 210/30 | Calculates magnitude of amplification of a sound wave. |
| ST 210/30 | Obtains information from a graph of a sound wave. |
| ST 210/30 | Calculates number of samples at a given frequency. |
| ST 210/30 | Locates amplitude and time readings from a sound wave graph. |
| ST 330/30 | Recognizes the units of current, voltage, resistance and frequency. |

PH.10 The student will investigate and understand that different frequencies and wavelengths in the electromagnetic spectrum are phenomena ranging from radio waves through visible light to gamma radiation. Key concepts include: the properties and behaviors of radio, microwaves, infra-red,

visible light, ultra-violet, X-rays, and gamma rays; and current applications based on the wave properties of each band.

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| ST 100/30 | Calculates how long it takes light to travel the circumference of the Earth. |
| ST 110/30 | Describes the characteristics of visible light images. |
| ST 150/30 | States the functions and properties of light and sound sensors when used as system inputs. |
| ST 160/30 | States the importance of using protection against the sun's rays. |
| ST 170/30 | Recognizes the properties of X-Rays as electromagnetic waves. |
| ST 170/30 | Extracts and interprets information from a text about X-Rays. |
| ST 200/30 | Identifies wavelength, frequency, and amplitude properties of electromagnetic waves. |
| ST 200/30 | Quantifies wavelength, frequency, and amplitude properties of electromagnetic waves. |
| ST 200/30 | Investigates the wavelength of a microwave. |
| ST 200/30 | Works with kilo, Mega and Giga prefixes when describing properties of electromagnetic waves. |
| ST 200/30 | Identifies the relationship between the frequency and bandwidth properties of electromagnetic |
| ST 200/30 | Identifies and describes ground waves, sky waves and space waves. |
| ST 200/30 | Identifies applications of reflected waves. |
| ST 200/30 | Defines the terms amplitude, frequency, range, wavelength and bandwidth. |
| ST 200/30 | Describes relationships between the values amplitude, frequency, range, wavelength and bandwidth. |
| ST 330/30 | Uses an oscilloscope to examine wave forms in an electronic circuit. |