West Virginia Science

Grades 9, 10, 11, 12

Adopted 2022

Earth and Space Science DOMAIN

Space Systems

1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation in relation to:
atomic structure
periodic table
energy transfer
fusion vs fission
structure of the sun
sunspots and other solar phenomenon (space weather). S.ESS.1
2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
expansion of the universe
frequency & wavelength
origin theories of the universe
blue shift/ redshift
Hubble constant
dark matter/dark energy
cosmic background radiation
EMspectrum
properties of light. S.ESS.2
3. Use at least two different formats (e.g., oral, graphical, textual, mathematical) to communicate scientific ideas about the way stars, over their life cycle, produce elements.
HR diagram
life cycle of stars
atomic theory
periodic table
fusion vs fission
nucleosynthesis. S.ESS.3
4. Use mathematical or computational representations (modeling) to predict the motion of orbiting objects in the solar system.
introduce velocity and acceleration
modeling Kepler's Laws
Newtonian Gravity. S.ESS.4

History of Earth

5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
Hypothesis of Continental Drift
fossil evidence
seafloor spreading
slab-push/plate pull
subduction
magnetic field reversal
oceanic vs continental crust. S.ESS.5

6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
xenoliths
radiometric dating
relative dating
cratering
moon origin theories. S.ESS.6

7. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features through a process of constructive and destructive forces.
constructive forces
volcanic activity
tectonic forces
mineral formation
rock formation
destructive forces
subduction
convection
coastal erosion
weathering
mass wasting. S.ESS.7

Earth's Systems

8. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
map and GIS data interpretation
examples could include:
coastal erosion
greenhouse gasses
global temperatures
rising ocean levels
loss of wetlands
acid rain
injection wells/earthquakes
loss of ground vegetation/erosion. S.ESS.8

9. Develop a model based on seismic and magnetic evidence of Earth's interior to describe the cycling of matter by thermal convection and the resulting plate tectonics.
layers of the Earth
density
heat transfer
temperature gradients
radioactive decay
differentiation
Earth's formation
chemical composition
seismic waves. S.ESS.9

10. Plan and conduct investigations of the properties of water and its effects on Earth materials and surface processes.
water cycle
mechanical & chemical weathering
chemical reactions
solutions
pH scale. S.ESS.10

11. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
biogeochemical cycles
carbon cycle
carbon reservoirs
carbon budget. S.ESS.11

12. Construct an argument based on evidence about the simultaneous coevolution of Earth systems and life on Earth.
Earth's history
evolution of earth's atmosphere
soil development
requirements for life and how they change with changing earth conditions. S.ESS.12

Weather and Climate

13. Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate.
changes in climate
orbital changes, precession, and Milankovitch cycles
volcanic impacts
ocean circulation impacts on atmosphere
glaciation
atmospheric composition. S.ESS.13

14. Analyze geoscience data and the results from the 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 systems.
local barometric pressure
precipitation
relative humidity
clouds
air temperature
surface temperature
rising sea level. S.ESS.14

Human Sustainability

15. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. Examples include:
access to fresh water-surface and groundwater
fertile soils-river deltas
fossil fuels and mining
natural disasters
severe weather
rising sea level
mass migrations. S.ESS.15

16. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. conservation, reuse, recycling
soil conservation
mining and drilling
rare earth mineral mining for technology products. S.ESS.16

17. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
cost of resource extraction
waste management
consumption
new technology development. S.ESS.17

18. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
data examples include:
point and non-point pollution
changes in biodiversity
land use via aerial or satellite imaging
deducing impact examples include:
local efforts in recycling
watershed or stream monitoring
geoengineering design solutions. S.ESS.18

19. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. hydrosphere
atmosphere
cryosphere
geosphere
biosphere
connection between carbon dioxide concentrations and photosynthetic biomass
ocean acidification
increasing ocean temperatures. S.ESS.19

Engineering, Technology, and Applications of Science DOMAIN

Engineering Design

20. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. In reference to: natural disasters
lack of water
resources
climate change. S.ESS.20
21. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. In reference to:
tsunamis
earthquakes
volcanic eruptions
flooding
coastal erosion
water quality. S.ESS.21
22. 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 in reference to:
tsunamis
earthquakes
volcanic eruptions
flooding
coastal erosion
water quality. S.ESS.22
23. 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 in reference to:
GIS
disaster simulations. S.ESS.23

Biology

Structure and Function

1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. S.B.1
2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. S.B.2
3. Identify and describe the characteristics of living organisms based on taxonomic classification systems. S.B.3
4. Develop and use a model to provide evidence that feedback mechanisms maintain homeostasis. S.B.4

Matter and Energy in Organisms and Ecosystems

S. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. S.B.S

6. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. S.B.6

7. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic respiration in different environments. S.B.7

8. Use mathematical representations to support claims for the cycling of matter and flow of energy between trophic levels in an ecosystem.
transfer of calories
energy loss (entropy)
10% Rule
bioaccumulation. S.B.8

9. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. S.B.9

Interdependent Relationships in Ecosystems

10. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. S.B.10

11. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. S.B.11

12. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem possibly leading to speciation. S.B.12

13. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. S.B.13

14. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. S.B.14

Inheritance and Variation of Traits

15. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. S.B.15
16. Develop and use a model to demonstrate the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. S.B.16
17. Make and defend a claim based on evidence that inheritable genetic variations may result from:
new genetic combinations through meiosis
viable errors occurring during replication
mutations caused by environmental factors. S.B.17
18. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. S.B.18

Natural Selection and Evolution

19. Engage in argumentation utilizing evidence to support common ancestry and biological evolution.
phylogenetic trees
cladograms. S.B.19
20. Construct an explanation based on evidence that the process of evolution primarily results from four factors:
potential for a species to increase in number heritable genetic variation of individuals in a species due to mutation and sexual reproduction
competition for limited resources
the proliferation of those organisms that are better able to survive and reproduce in the environment. S.B.20
21. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. S.B.21
22. Evaluate the evidence supporting claims that changes in environmental conditions drive natural selection. S.B.22

Engineering Design

23. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.B.23
24. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.B.24
25. 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. S.B.25
26. 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. S.B.26

Physical Science/Chemistry

Structure and Properties of Matter

1. Perform calculations involving equivalence statements for English and Metric conversions (e.g., Newtons/kg/lbs., km/mi., kg/g, km/m). S.PS.1
2. Compare and contrast the properties of matter to classify as homogeneous or heterogeneous; pure substance or mixture; element or compound; metals, nonmetals, or metalloids; solution, colloid or suspension. S.PS.2
3. Plan and conduct an investigation to distinguish chemical properties of matter from physical properties of matter including boiling point, freezing/melting point, density, solubility, viscosity, and conductivity. S.PS.3
4. Compare the subatomic particles of an atom with regard to mass, location, and charge, then explain how these particles affect the properties of an atom including identity, mass, volume, and reactivity. S.PS.4
5. Analyze data and interpret the Periodic Table to determine trends of the following: number of valence electrons
types of ions formed by main group elements
location and properties of metals, nonmetals, metalloids state phases at room temperature. S.PS.5
6. Identify the names/formulas of ionic and molecular compounds and simple-chained hydrocarbons based on the bonding arrangement and structures of molecules. S.PS.6
7. Investigate the properties of substances to classify them based on the relative strengths of ionic, covalent, and metallic bonds. S.PS.7
8. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. S.PS.8

Chemical Reactions

9. Analyze experimental evidence to distinguish between chemical and physical reactions. S.PS.9
10. Use mathematical representations to support the claim that atoms, mass, energy, and charge are conserved during a chemical reaction. S.PS.10
11. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. S.PS.11
12. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. S.PS.12
13. Use models to identify chemical reactions as synthesis, decomposition, single-replacement, and double-replacement. Given the reactants, use these models to predict the products of those chemical reactions. S.PS.13
14. Experimentally evaluate the characteristics and interactions of acids and bases. S.PS.14

Physical Science/Physics

Energy

15. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. S.PS.15
16. Evaluate the forces of a system to quantify the change in energy of a system as work and interpret the rate of energy changes as power. S.PS.16
17. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. S.PS.17
18. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics). S.PS.18
19. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. S.PS.19

Forces and Interactions

20. Experimentally generate graphical data of distance, speed/velocity, and acceleration to analyze the motion of an object and justify and/or derive kinematic equations. S.PS.20
21. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. S.PS.21
22. Identify the pair of equal and opposite forces between two interacting bodies and relate their magnitudes and directions using Newton's 3rd Law. S.PS.22
23. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when the system is closed. S.PS.23
24. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. S.PS.24
25. Develop and use a model to describe the mathematical relationship between mass, distance, and force as expressed by Newton's Universal Law of Gravitation. S.PS.25

Waves and Electromagnetic Radiation

26. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media while differentiating between longitudinal and transverse waves. S.PS.26
27. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. S.PS.27
28. Qualitatively analyze the law of reflection, the law of refraction, and the relationship between the angle of incidence and angle of refraction. S.PS.28
29. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy (e.g., broadband, Bluetooth, satellites, and WiFi). S.PS.29

Engineering Design

30. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.PS.30
31. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.PS.31
32. 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. S.PS.32
33. 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. S.PS.33

Chemistry/Physical Science

Structure and Properties of Matter

1. Use systematic rules for measuring with certainty to determine intrinsic and extrinsic properties of matter relating to:
specific heat
density
melting point
freezing point
boiling point
color, volume, length, mass, weight, texture. S.C.1
2. Calculate properties of matter using the significant figure rules for addition/subtraction and multiplication/division and correctly reporting answers using scientific notation. S.C.2
3. Compare and contrast the properties of matter to classify as homogeneous or heterogeneous; pure substance or mixture; element or compound; metals, nonmetals, or metalloids; solution, colloid or suspension, including relative strengths of ionic, covalent, and metallic bonds. S.C.3
4. Research and evaluate contributions (e.g., experimental design, atomic models) to the evolution of the atomic theory in relation to:
isotopes
atoms
ions
atomic notation. S.C.4
5. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms in relation to:
atomic size
ionic size
electronegativity
ionization energy
electron affinity. S.C.5
6. Describe atoms and molecules using the Quantum and VSEPR (Valence Shell Electron Pair Repulsion) theories. S.C.6
7. Produce electron configurations and orbital diagrams for any element on the periodic table and predict the chemical properties of the element from the electron configuration. S.C.7
8. Construct the names/formulas of ionic and molecular compounds and simple-chained hydrocarbons based on the bonding arrangement and structures of molecules. S.C.8
9. Investigate and explain water's role as a solvent based upon its physical, chemical, and colligative properties. S.C.9
10. Apply the relationship among pressure, temperature, and volume of a gas utilizing graph construction and data generation to illustrate the gas laws in reference to: Ideal Gas Law
Boyle's Law
Charles's Law
Combined Gas Law. S.C.10
11. Construct and interpret a phase diagram/heating curve for a substance identifying boiling point, melting point, triple point, and critical point. S.C.11

Chemical Reactions

12. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. S.C.12
13. Classify, predict products of, and write balanced equations for chemical reaction types including single replacement, double replacement, composition, decomposition, combustion, redox, and neutralization. S.C.13
14. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. S.C.14
15. Generate mole conversions that demonstrate correct application of Avogadro's number, molar mass, density, scientific notation, and significant figures in reference to:
mass to number of particles
number of particles to volume
volume to mass. S.C.15
16. Perform the following "mole" calculations showing answers rounded to the correct number of significant figures:
molarity
percentage composition
empirical formulas
molecular formulas
formulas of hydrates
mole-mole and mass-mass stoichiometry
determination of limiting reactant
theoretical yield. S.C.16
17. Classify exothermic & endothermic reactions by the direction of heat flow in a chemical reaction as observed by changes in temperature. S.C.17

Applications of Chemical Reactions

18. Compare and contrast the defining characteristics of the characteristics of the Arrhenius theory of acids and bases and Bronsted-Lowry theory of acids and bases. S.C.18
19. Investigate the chemical and physical properties of acids and bases and evaluate their applications. S.C.19
20. Compare methods of measuring pH:
chemical indicators
indicator papers
pH meters. S.C.20
21. Analyze the pH of solutions based on the logarithmic pH scale and concentrations of hydronium or hydroxide ions. S.C.21
22. Plan and conduct an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent then develop a model to illustrate the process of dissolving. S.C.22
23. Measure, quantitatively compare and interpret solubility curves of chemical species in solution types including unsaturated and supersaturated solutions. S.C.23
24. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. S.C.24
25. Design a properly working electrolytic cell based on redox principles. S.C.25
26. 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. S.C.26
27. Communicate scientific and technical information about why the molecular-level structure and shape is important in the functioning of designed materials in reference to:
polymers
plastics
pharmaceuticals
vaccines. S.C.27

Engineering Design

28. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.C.28
29. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.C.29
30. 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. S.C.30
31. 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. S.C.31

Physics/Physical Science

Forces and Interactions

1. Use systematic rules for measuring with certainty and accurately perform calculations using significant figure rules for addition/subtraction and multiplication/division to determine distance, speed/velocity, and acceleration of objects. S.P.1
2. Interpret graphical, algebraic, and/or trigonometric solutions to prove the values for vector components and resultants. S.P.2
3. Develop free body diagrams to define a system experiencing balanced or unbalanced forces to justify Newton's Laws of Motion. S.P.3
4. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. S.P.4
5. Identify the pair of equal and opposite forces between two interacting bodies and relate their magnitudes and directions using Newton's 3rd Law. S.P.5
6. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when the system is closed. S.P.6
7. Evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions. S.P.7
8. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. S.P.8
9. Develop and use a model to describe the mathematical relationship between mass, distance, and force as expressed by Newton's Universal Law of Gravitation. S.P.9
10. Analyze the motion of a projectile; appraise data, either textbook generated or laboratory collected, for motion in one and/or two dimensions, then select the correct mathematical method for communicating the value of unknown variables. S.P.10

Energy

11. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. S.P.11
12. Evaluate the conservation of energy and momentum and deduce solutions for elastic and inelastic collisions. S.P.12
13. Evaluate the forces of a system to quantify the change in energy of a system as work and interpret the rate of energy changes as power. S.P.13
14. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. S.P.14
15. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics). S.P.15

States of Matter

16. Conduct experiments to evaluate the application of metals based on internal structure and physical properties in relation to:
thermal expansion
electrical/thermal conductivity
magnetism. S.P.16
17. Assess the magnitude of buoyant force on submerged and floating objects. S.P.17
18. Evaluate the compressibility of fluids and apply the equation of continuity to analyze the mass flow rate of incompressible fluids. S.P.18
19. Anticipate the effects of Bernoulli's principle on fluid motion. S.P.19

Waves and Electromagnetic Radiation

20. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media while differentiating between longitudinal and transverse waves. S.P.20
21. Evaluate the claims, 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. S.P.21
22. Calculate the energy from electromagnetic radiation with differing frequencies that are absorbed by matter then propose possible applications for those materials. S.P.22
23. Apply ray optics diagrams to lenses and mirrors; use the lens/mirror equation and the magnification equation to solve optics problems; justify the image results obtained by diagramming the ray optics of lenses and mirrors and/or by deducing the image information from the lens/mirror equation. S.P.23
24. Apply Snell's Law to calculate either the angle of incidence or angle of refraction for refraction through various media. S.P.24
25. Make claims about the diffraction/interference patterns produced when a wave passes through a small opening/set of openings. S.P.25
26. Evaluate the photon model of light with evidence of the photoelectric effect. S.P.26

Electricity and Magnetism

27. Diagram magnetic fields for different types of magnets and evaluate the strength of magnetic fields based on field line density. S.P.27
28. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. S.P.28
29. Generate models of electric fields surrounding point charges and calculate the magnitude of electric force applied to a charge when placed at different positions in the electric field. S.P.29
30. Qualitatively and quantitatively predict the interactions of charged particles when performing calculations using Coulomb's Law. S.P.30
31. Construct and analyze electrical circuits and calculate Ohm's law problems for series and parallel circuits. S.P.31
32. Distinguish between direct and alternating current and identify ways of generating each type. S.P.32

Engineering Design

33. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.P.33
34. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.P.34
35. 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. S.P.35
36. 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. S.P.36

Environmental Science

1. **Compare and contrast the rate elements cycle through the ecosphere, describing natural and human influences on reaction rates:
carbon
nitrogen
phosphorus
oxygen
sulfur.
** S.ENV.1
2. **Explain how the chemical components of biological and physical processes fit in the overall process of biogeochemical cycling such as photosynthesis, respiration, nitrogen fixation, or decomposition.** S.ENV.2
3. **Analyze and evaluate the use and availability of renewable and nonrenewable energy resources:
coal
solar
biomass
biofuels
hydropower
natural gas
wind
geothermal
nuclear.
** S.ENV.3

4. **Evaluate environmental and economic advantages and disadvantages of using nonrenewable and renewable energy.** S.ENV.4

5. **Differentiate various means of generating electricity in terms of the transformation of energy among forms, the relationship of matter and energy, and efficiency/production of heat energy.** S.ENV.5

6. **Explain how technology has influenced the sustainability of natural resources over time:
forestry practices
fossil fuels
farming.
** S.ENV.6

7. **Relate logistic, exponential, and irruptive population growth to population dynamics including:
natural selection
predator/prey relationships
reproductive strategies
carrying capacity
limiting factors.
** S.ENV.7

8. **Create food web diagrams to explain how adding and/or removing a species from an ecosystem may affect other organisms and the entire ecosystem.** S.ENV.8

9. **Evaluate the leading causes of species decline and premature extinction:
habitat destruction and degradation
invasive species
pollution
human population growth
over exploitation.
** S.ENV.9

10. **Analyze biological diversity as it relates to the stability of an ecosystem.** S.ENV.10

11. **Relate habitat changes to plant and animal populations and climate influences:
variations in habitat size
fragmentation
fluctuation in conditions of abiotic factors
albedo
surface temperature.
** S.ENV.11

12. **Compare and contrast local, state, and federal legislation and international agreements associated with protecting habitats, ecosystems, and species:
Superfund (CERCLA)
Surface Mining Control and Reclamation Act
Wilderness Act
Endangered Species Act
Marine Mammals Act
Wild Flora and Fauna (CITES).
** S.ENV.12

13. **Illustrate how changes in wind patterns or ocean temperatures can affect weather in different parts of the world:
El Nino
La Nina
Santa Ana winds.
** S.ENV.13

14. **Identify natural and anthropogenic sources of primary, secondary, and indoor air pollutants and the resulting environmental and health effects.** S.ENV.14

15. **Explain the formation of acid rain and describe the resulting effect on soil, plants, water, and statues.** S.ENV.15

16. **Identify causes for the thinning of the ozone layer and evaluate the effectiveness of the Montreal Protocol for reducing ozone depletion.** S.ENV.16

17. **Debate climate change as it relates to natural forces, greenhouse gases, human changes in atmospheric concentrations of greenhouse gases, and relevant laws and treaties.** S.ENV.17

18. **Identify sources, uses, quality, conservation, and global distribution of water.** S.ENV.18

19. **Create models to show surface and groundwater flows in a local drainage and explain how surface and ground water are related.** S.ENV.19

20. **Contrast point source and non-point source water pollutants.** S.ENV.20

21. **Use GIS data to analyze the parameters of a watershed and interpret physical, chemical, and biological data as a means of assessing environmental quality.** S.ENV.21

22. **Examine legislation associated with the protection of water:
Clean Water Act
London Dumping Convention of 1972.
** S.ENV.22

23. **Describe the processes involved and compare different methods of wastewater treatment.** S.ENV.23

24. **Utilize soil classification and analysis methods to make recommendations for soil conservation practices. Analysis could include the following: texture
moisture content
supported vegetation color
pH
porosity
nitrogen
phosphorus potassium
organic compounds.
** S.ENV.24

25. **Analyze best management practices of the agriculture business: fertilizers
integrated pest management
associated water pollution
irrigation practices
agricultural waste. ** S.ENV.25

26. **Research and describe how communities have restored or protected ecosystems:
remediation
mitigation
rehabilitation reclamation
preservation.
** S.ENV.26

27. **Evaluate solid waste management practices:
recycling incineration
sanitary landfills
hazardous waste disposal. ** S.ENV.27

Engineering Design

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29. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.ENV.29
30. 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. S.ENV.30
31. 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. S.ENV.31

Forensic Science

1. **Identify evidence which encompasses materials establishing a link between a crime and its victim or a crime and its perpetrator:
impressions (tire, tool, teeth, shoes)
prints (finger, lip, voice)
hair and fiber analysis
drugs and poisons
ballistics
soil and pollen
glass
serology
questioned documents.
** S.FS.1
2. **Distinguish between types of evidence:
testimonial
physical: individual and class
quantitative
qualitative.
** S.FS.2
3. **Analyze modes of transfer and the factors affecting persistence of evidence (Locard's Exchange Principle):
indirect
direct
** S.FS.3
4. **Demonstrate steps of crime scene processing:
note-taking
photography
sketching to scale
evidence collection
chain of custody.
** S.FS.4
5. **Validate, classify, and analyze fingerprints as individual evidence:
type
pattern
minutiae.
** S.FS.5
6. **Model techniques of collecting and developing prints on various objects and textures:
physical (dusting powders)
chemical (ninhydrin, iodine, cyanoacrylate).
** S.FS.6
7. **Examine the absorption and effects of toxins in the human body:
alcohol
drugs
poisons.
** S.FS.7
8. **Identify known and unknown substances utilizing the techniques of forensic toxicology:
white powders
blood alcohol
over the counter/illicit drugs
gas chromatography charts.
** S.FS.8
9. **Discuss and cite evidence of biological and chemical hazards and their impact on society and the environment:
arson
bombs
bioterrorism
environmental terrorism.
** S.FS.9

10. **Apply forensic entomology to assess a crime scene:
Berlese funnel
life cycles.
** S.FS.10

11. **Analyze bones and teeth as forensic evidence:
type
articulation
origin
sex
age
race
stature
disease/injury.
** S.FS.11

12. **Analyze blood samples as evidence:
ABO system
Rh factor
DNA fingerprinting
blood spatter.
** S.FS.12

13. **Investigate forensic applications of chromatography:
inks and dyes
cosmetics
calculation of Rf values.
** S.FS.13

14. **Explore earth science concepts as they relate to forensic science:
rock and mineral identification
classify soils' common constituents in relation to crime scene location.
** S.FS.14

15. **Identify and describe agents and processes of degradation of evidence:
weathering
scavengers.
** S.FS.15

16. **Solve multi-step problems involving velocity, acceleration, net force, and projectile motion during analysis of crime scene:
Ballistics
vehicular collisions.
** S.FS.16

17. **Utilize biometric techniques for forensic science investigations:
prints
recognition scans
anthropometry.
** S.FS.17

18. **Research and evaluate technological advances and careers related to the field of forensics.** S.FS.18

19. **Investigate and analyze forensic evidence using handwriting analysis, forgery, and counterfeiting.** S.FS.19

Engineering Design

20. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.FS.20

21. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.FS.21

22. 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. S.FS.22

23. 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. S.FS.23

Human Anatomy and Physiology

1. Apply directional terminology to locate human body structures:
superior-inferior
dorsal-ventral
proximal-distal
medial-lateral
superficial-deep. S.HAP.1
2. Describe the organizational levels, interdependency, and the interaction of:
cells
tissues
organs
organ systems. S.HAP.2
3. Categorize, by structure and function, the four main human tissue types:
muscle
epithelial
connective
nervous. S.HAP.3
4. Relate the structure of the integumentary system to its function as a/an:
sensory organ
environmental barrier
temperature regulator. S.HAP.4
5. Relate how bone tissue is important to the development of the human skeleton. S.HAP.5
6. Correlate the structure and function of the elements of the skeletal system:
bone
articulations
insertions. S.HAP.6
7. Model the mechanisms of muscular contraction on the cellular and molecular levels. S.HAP.7
8. Integrate the skeletal, muscular, and nervous systems to the functioning of the organism. S.HAP.8
9. Model the muscular system including:
locations
origins
insertions
muscle groups
types of muscles. S.HAP.9
10. Classify the various types of neurons emphasizing the relationship of structure and function. S.HAP.10
11. Model the mechanism of a nerve impulse at the cellular and molecular levels. S.HAP.11
12. Compare and contrast the parts and functions of the central and peripheral nervous system including the autonomic portions. S.HAP.12
13. Apply the structure of the ear and eye to their function/dysfunction in relation to environmental perception. S.HAP.13
14. Apply the action of specific enzymes to their roles in bodily functions. S.HAP.14
15. Incorporate the role of endocrine glands and their hormones into the overall functions and dysfunctions of the body. S.HAP.15
16. Analyze the role of components and processes of the digestive system in supplying essential nutrients. S.HAP.16

17. **Explain how structures of the respiratory system are essential to cellular respiration, gas exchange and communication.** S.HAP.17

18. **Illustrate the structures of the circulatory and lymphatic systems and the function of blood to the role of:
transportation
cellular support
defense.
** S.HAP.18

19. **Compare the compatibility of blood types and assess the molecular basis for blood functions.** S.HAP.19

20. **Integrate the functions of the excretory system to the maintenance of the other body systems.** S.HAP.20

21. **Compare and contrast the structure and function of male and female reproductive systems.** S.HAP.21

22. **Outline the events of reproduction for the formation of gametes through fertilizations and embryological development.** S.HAP.22

23. **Assess the role of components of the immune system in defending the body.** S.HAP.23

24. **Research disease causative factors, symptoms, prevention, and treatment.** S.HAP.24

Engineering Design

25. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. S.HAP.25

26. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. S.HAP.26

27. 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. S.HAP.27

28. 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. S.HAP.28