SCIENCE OLYMPIAD
Exploring the World of Science

2019 NATIONAL SCIENCE OLYMPIAD
&
NEXT GENERATION SCIENCE STANDARDS ALIGNMENT

DIVISION C (HIGH SCHOOL; GRADES 9-12)

ANATOMY AND PHYSIOLOGY – Understand the anatomy and physiology of human body systems.

High School Life Science

HS. Structure and Function

HS-LS 1–2. Develop and use a model to illustrate the hierarchical organization of interacting systems to provide specific functions within multicellular organisms.

HS-LS 1–3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

ASTRONOMY – Teams will demonstrate an understanding of stellar evolution in normal & starburst galaxies.

High School Earth and Space Science

HS. Space Systems

HS-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.

HS-ESS 1–3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

BOOMILEVER – Teams will design and build a Boomilever meeting requirements specified in these rules to support a minimum load and achieve the highest structural efficiency.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

CHEMISTRY LAB – Teams will complete one or more tasks and answer a series of questions involving the science processes of chemistry focused in the areas of Physical Properties and Acids & Bases.

High School Physical Science

HS. Structure and Properties of Matter

HS-PS 1–1. 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.

HS-PS 1–3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS. Chemical Reactions

HS-PS 1–2. 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.

HS-PS 1–4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS 1–5. 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.

HS-PS 1–6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS-PS 1–7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

CIRCUIT LAB – Participants must complete tasks and answer questions about electricity and magnetism.

High School Physical Science

HS. Forces and Interactions

HS-PS 2-4. – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS 2-5. – 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.

HS. Energy

HS-PS3-1. – Create a computational model to calculate the change in energy of one component in a system when the change in energy of the other component(s) and energy flows in an dout of the system are known.

HS-PS3-2. – Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

HS-PS3-5. – Develop and use models 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.

CODEBUSTERS – Teams will cryptanalyze (decode) encrypted messages using cryptanalysis techniques and show skill with advanced ciphers by encrypting or decrypting a message.

K-12 Computer Science Framework

9-12 Computing Systems

Devices - Computing devices are often integrated with other systems, including biological, mechanical, and social systems. These devices can share data with one another. The usability, dependability, security, and accessibility of these devices, and the systems they are integrated with, are important considerations in their design as they evolve.

9-12 Algorithms and Programming

Algorithms - People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

9-12 Networks and the Internet

Cybersecurity - Network security depends on a combination of hardware, software, and practices that control access to data and systems. The needs of users and the sensitivity of data determine the level of security implemented.

DESIGNER GENES – Participants will solve problems and analyze data or diagrams using their knowledge of the basic principles of genetics, molecular genetics, and biotechnology.

High School Life Science

HS. Inheritance and Variation of Traits

HS-LS 3-1. – Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS 3-2. – Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS 3-3. – Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

DISEASE DETECTIVES – Participants will use their investigative skills in the scientific study of disease, injury, health, and disability in populations or groups of people.

High School Life Science

HS. Structure and Function

HS-LS 1–2. Develop and use a model to illustrate the hierarchical organization of interacting systems to provide specific functions within multicellular organisms.

HS-LS 1–3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS. Interdependent Relationships in Ecosystems

HS-LS 2-1. – Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS 2-2. – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS 2-6. – 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.

HS-LS 2-7. – Design, evaluate, and refine a solution for reducing the impact of human activities on the environment and biodiversity.

HS-LS 2-8. – Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS 4-6. – Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS. Natural Selection and Evolution

HS-LS 4-3. – Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking the trait.

HS-LS 4-4. – Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS 4-5. – Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-1. – Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

DYNAMIC PLANET – Students will use process skills to complete tasks related to glaciers, glaciation, and long-term climate change.

High School Earth and Space Sciences

HS. History of Earth

HS-ESS 2-1. – 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.

HS. Weather and Climate

HS-ESS 2-4. – Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS 3-5. – Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS. Earth's Systems

HS-ESS 2-5. – Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS 2-7. – Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

HS. Human Sustainability

HS-ESS 3-1. – 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.

HS-ESS 3-4. – Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS 3-6. – Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

EXPERIMENTAL DESIGN – This event will determine the participant's ability to design, conduct, and report the findings of an experiment conducted entirely on site.

Note: *The exact nature of the experiment conducted during the Experimental Design event changes depending upon the tournament site. Therefore, matching this event to exact standards can be problematic. The standards listed below might be addressed at a given tournament.*

High School Physical Science

HS. Chemical Reactions

HS-PS 1-4. – Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS 1-5. – 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.

HS-PS 1-6. – Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS. Forces and Interactions

HS-PS 2-1. – 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.

HS-PS 2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS 2-5. 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.

HS. Energy

HS-PS 3-3. – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS 3-4. – 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).

HS-PS 3-5. – 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.

High School Life Science

HS. Structure and Function

MS-LS 1–3. – Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

FERMI QUESTIONS – Teams provide answers to a series of "Fermi Questions"; science related questions that seek fast, rough estimates of a quantity, which is either difficult or impossible to measure directly.

High School Physical Science

HS. Chemical Reactions

HS-PS 1-7. – Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

HS-PS 1-8. – Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS. Forces and Interactions

HS-PS 2-2. – Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS 2-4. – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS. Waves and Electromagnetic Radiation

HS-PS 4-1. – Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various modes.

High School Life Science

HS. Interdependent Relationships in Ecosystems

HS-LS 2-1. – Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS 2-2. – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scale.

HS-LS 2-4. – Use mathematical representations to support claims for cycling of matter and flow of energy in aerobic and anaerobic conditions.

High School Earth and Space Science

HS. Space Systems

HS-ESS 1-4. – Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS. Earth's Systems

HS-ESS 2-6. – Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

FORENSICS – Given a scenario and some possible suspects, students will perform a series of tests. These tests, along with other evidence or test results, will be used to solve a crime.

High School Physical Science

HS. Structure and Properties of Matter

HS-PS 1-1. – 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.

HS-PS 1-3. – Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

High School Life Science

HS. Inheritance and Variation of Traits

HS-LS 3-1. – Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS 3-3. – Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

FOSSILS – Teams use fossils to date and correlate rock units as well as demonstrate their knowledge of ancient life by completing tasks related to fossil identification and classification.

High School Earth and Space Science

HS. Earth's Systems

HS-ESS 2-5. – Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS 2-7. – Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

GEOLOGIC MAPPING – Teams will demonstrate understanding in the construction and use of topographic maps, geologic maps, and cross sections, and their use in forming interpretations regarding subsurface structures and geohazard risks especially with respect to subduction zones.

High School Earth and Space Sciences

HS. History of Earth

HS-ESS 2-1. – 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.

HS. Human Sustainability

HS-ESS 3-1. – 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.

HERPETOLOGY – Participants will be assessed on their knowledge of amphibians and reptiles.

High School Life Science

HS. Interdependent Relationships in Ecosystems

HS-LS 2-8. - Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS. Natural Selection and Evolution

HS-LS 4-1. - Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS 4-2. - Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

MISSION POSSIBLE – Participants design, build, test, and document a Rube Goldberg®-like device that completes a required action through an optional series of specific actions.

High School Physical Science

HS. Energy

HS-PS 3-3. – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

MOUSETRAP VEHICLE – Teams must design, build and test a vehicle using one, or two, snap mousetraps as its sole means of propulsion.

High School Physical Science

HS. Forces and Interactions

HS-PS 2-1. – 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.

HS. Energy

HS-PS 3-3. – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

PROTEIN MODELING – Students will use computer visualization and online resources to construct physical models of the CRISPR Cas9 protein, that is being engineered to edit plant and animal cell genomes, and answer a series of questions about the chemistry of protein folding and the interaction of structure and function for model proteins.

High School Physical Science

HS. Structures and Properties of Matter

HS-PS 1–1. 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.

HS-PS 1–2. 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.

HS-PS 1–3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

High School Life Sciences

HS. Structure and Function

HS-LS 1-1. – 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.

HS-LS 1-6. – Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

SOUNDS OF MUSIC – Teams must construct and tune one device prior to the tournament based on a 12-tone equal tempered scale and complete a written test on the physics of sound.

High School Physical Science

HS. Energy

HS-PS 3–1. Create a computational model to calculate the change in the energy of once 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.

HS-PS 3–3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS. Waves and Electromagnetic Radiation

HS-PS 4–1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

THERMODYNAMICS – Teams must construct an insulating device prior to the tournament that is designed to retain heat and complete a written test on thermodynamic concepts.

High School Physical Science

HS. Chemical Reactions

HS-PS 1-5. – 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.

HS. Energy

HS-PS 3-4. – 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).

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

WATER QUALITY – Participants will be assessed on their understanding and evaluation of aquatic environments.

High School Life Science

HS. Interdependent Relationships in Ecosystems

HS-LS 2-1. - Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS 2-2. - Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS 2-6. - 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.

HS-LS 2-7. - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

WRIGHT STUFF – Prior to the tournament teams design, construct, and test free flight rubber-powered monoplanes to achieve maximum time aloft.

High School Physical Science

HS. Forces and Interactions

HS-PS 2-1. – 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.

HS. Energy

HS-PS 3-3. – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

High School Engineering Design

HS. Engineering Design

HS-ETS 1-2. – Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

HS-ETS 1-3. – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS 1-4. – Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

WRITE IT/DO IT – One participant will write a description of an object and how to build it. The other participant will attempt to construct the object from this description.

Common Core English Language Arts Standard

Writing

Writing. Grade 9-10.2 - Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Writing. Grade 11-12.2 - Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

K-12 Computer Science Framework

9-12 Algorithms and Programming

Algorithms - People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

Program Development – Diverse teams can develop programs with a broad impact through careful review and by drawing on the strengths of members in different roles. Design decisions often involve tradeoffs. The development of complex programs is aided by resources such as libraries and tools to edit and manage parts of the program. Systematic analysis is critical for identifying the effects of lingering bugs.