2022 NATIONAL SCIENCE OLYMPIAD

DIVISION B (MIDDLE SCHOOL; GRADES 6-9)

EVENT ALIGNMENT TO NATIONAL EDUCATIONAL STANDARDS

ANATOMY AND PHYSIOLOGY – Participants will be assessed on their understanding of the anatomy and physiology for the human **Nervous, Sense Organs, and Endocrine** systems.

Middle School Life Science

MS. Structure, Function, and Information Processsing

MS-LS 1–3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

BIO PROCESS LAB – This event is a lab-oriented competition involving the fundamental science processes of a middle school life science/biology lab program.

Middle School Life Science

MS. From Molecules to Organisms: Structures and Processes

MS-LS 1-1. – Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

MS-LS 1-2. – Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

MS-LS 1-5. – Construct a scientific explanation based on evidence for how environmental and genic factors influence the growth of organisms.

MS-LS 1-7. – Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as matter moves through an organism.

MS. Ecosystems: Interactions, Energy, and Dynamics

MS-LS 2-1. – Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS 2-2. – Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

BRIDGE – Teams will design and build a **Bridge** (Structure) meeting requirement specified in these rules to achieve the highest structural efficiency.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

CRIME BUSTERS – Given a scenario, a collection of evidence, and possible suspects, students will perform a series of tests. The test results along with other evidence will be used to solve a crime.

Middle School Physical Science

MS. Chemical Reactions

MS-PS 1-2. - Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS. Structures and Properties of Matter

MS-PS 1–3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

CODEBUSTERS – Teams will cryptanalyze and decode encrypted messages using cryptanalysis techniques for historical and modern advance ciphers.

K-12 Computer Science Framework

6-8 Networks and the Internet

Cybersecurity - Explain how physical and digital security measures protect electronic information.

Cybersecurity - Apply multiple methods of encryption to model the secure transmission of information.

CRAVE THE WAVE – In this event competitors must demonstrate knowledge and process skills needed to solve problems and answer questions regarding all types of waves and wave motion.

Middle School Physical Science

MS. Waves and Their Applications in Technologies for Information Transfer

MS-PS 4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy of the wave.

MS-PS 4-2. Develop and use a model to describe that waves are reflected absorbed, or transmitted through various materials.

MS-PS 4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encde and transmit information than analog signals.

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

Middle School Life Science

MS. Growth, Development, and Reproduction of Organisms

MS-LS 1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS. Interdependent Relationships in Ecosystems

MS-LS 2-2. - Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS. Matter and Energy in Organisms and Ecosystems

MS-LS 2-4. - Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS. Natural Selection and Adaptations

MS-LS 4-4. - Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

Middle School Earth and Space Sciences

MS. Human Impacts

MS-ESS 3-4. - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

DYNAMIC PLANET – Students will use process skills to complete tasks related to Earth's fresh waters.

Middle School Earth and Space Sciences

MS. Earth's Systems

MS-ESS 2-4. - Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS 2-6. - Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates..

MS. Earth and Human Activity

MS-ESS 3-1. – Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

MS-ESS 3-3. - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

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

Middle School Physical Science

MS. Forces and Interactions

MS-PS 2-1. - Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

MS. Energy

MS-PS 3-5. - Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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 are ones that might be addressed at any given tournament.*

Middle School Physical Science

MS. Chemical Reactions

MS-PS 1-2. - Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS 1-5. - Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

MS. Structures and Properties of Matter

MS-PS 1-4. - Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MS. Forces and Interactions

MS-PS 2-2. - Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-PS 2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

MS. Energy

MS-PS 3-1. - Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS 3-4. - Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Middle School Life Science

MS. Structure, Function, and Information Processing

MS-LS 1–1. - Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

MS. Matter and Energy in Organisms and Ecosystems

MS-LS 1–6. - Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

FOOD SCIENCE – Participants will answer questions on food chemistry with **a focus on sugars**. **In addition, participants will build a hydrometer capable of measuring sugar solutions between 1-10% (mass/ volume).**

Middle School Physical Science

MS. Matter and Its Interactions

MS-PS 1-2. - Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Middle School Life Science

MS. From Molecules to Organisms: Structures and Processes

MS-LS 1-7. – Develop a model tp describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

GREEN GENERATION – Students will demonstrate an understanding of general ecological principles, the history and consequences of human impact on our environment, solutions to reversing trends and sustainability concepts.

Middle School Life Sciences

MS. Ecosystems: Interactions, Energy, and Dynamics

MS-LS 2–1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS 2–2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS 2–3. Develop a model to describe the cycling of mater and flow of energy among living and non-living parts of an ecosystem.

Middle School Earth and Space Science

MS. Earth and Human Activity

MS-ESS 3–4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

METEOROLOGY – Participantswillusescientificprocessskillsandquantitativeanalysistodemonstrate an understanding of the factors that influence world climate and climate change through the interpretation of climatological data, graphs, charts and images.

Middle School Earth and Space Sciences

MS. Earth's Systems

MS-ESS 2-5. - Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

MS-ESS 2-6. - Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates

MS. Earth and Human Activity

MS-ESS 3-2. - Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MISSION POSSIBLE – Prior to the competition, participants design, build, test, and document a Rube Goldberg®-like Device that completes required Start and Final Actions through a series of specific actions.

Middle School Physical Sciences

MS. Energy

MS-PS 3-5. – Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MOUSETRAP VEHICLE – Teams design, build, and test one Vehicle using one mousetrap as its sole means of propulsion to reach a target as quickly and accurately as possible.

Middle School Physical Science

MS. Forces and Interactions

MS-PS 2-1. - Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

MS. Energy

MS-PS 3-5. - Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

ORNITHOLOGY – Participants will be assessed on their knowledge of North American birds.

Middle School Life Science

MS. Growth, Development, and Reproduction of Organisms

MS-LS 1-4. - Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS. Natural Selection and Adaptations

MS-LS 4-2. - Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships

MS-LS 4-3. - Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

PING PONG PARACHUTE – Prior to the tournament, teams will design, build, and bring up to two bottle rockets to the tournament to launch a ping pong ball attached to a parachute to stay aloft for the greatest amount of time.

Middle School Physical Science

MS. Forces and Interactions

MS-PS 2-2. - Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-PS 2-4. – Construct and present arguments using evidence to support thr claim that gravitational interactions are attractive and depend upon the masses of interacting objects.

MS. Energy

MS-PS 3-1. – Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object.

MS-PS 3-5. – Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

ROAD SCHOLAR – Teams will answer interpretive questions that may use one or more state highway maps, USGS topographic maps, Internet-generated maps, a road atlas or satellite/aerial images.

Middle School Earth and Space Sciences

MS. History of Earth

MS-ESS 2-3. – Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

MS. Erath's Systems

MS-ESS 3-1. – Construct a scientific explanation based on evidence for how the uneven distribution of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

ROCKS AND MINERALS – Participants will demonstrate their knowledge of rocks and minerals.

Middle School Physical Sciences

MS-PS1 Matter and Its Interactions

HS-PS 1–2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Middle School Earth and Space Science

MS-ESS1 Earth's Place in the Universe

MS-ESS 1–4. Construct a scientific explanation based on evidence from rock strata for how the geologic timescale is used to organize Earth's 4.6 billion-year-old history.

MS-ESS2 Earth's Systems

MS-ESS 2–1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS 2–2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

MS-ESS 2–3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.

SOLAR SYSTEM – Students will demonstrate an understanding and knowledge of **planet formation and structure** in our solar system and how it relates to that observed in **extrasolar systems.**

Middle School Earth and Space Sciences

MS-ESS1 Earth's Place in the Universe

MS-ESS 1–3. Analyze and interpret data to determine scale properties of objects in the solar system.

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

Middle School Physical Science

MS. Energy

MS-PS 3–1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS 3–5. Construct, use, and present arguments to support the claim that when kinetic energy of an object changes, energy is transferred to or from an object.

MS. Waves and Electromagnetic Radiation

MS-PS 4–1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS 4–2. Develop and use a model to describe that wave are reflected, absorbed, or transmitted through various media.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

STORM THE CASTLE – Prior to the competition, teams will design, construct, and calibrate a single device capable of launching projectiles onto a target and collect data regarding device parameters and performance.

Middle School Physical Sciences

MS. Motion and Stability: Forces and Interactions

MS-PS 2-2. – Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS. Energy

MS-PS 3–1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS 3–5. Construct, use, and present arguments to support the claim that when kinetic energy of an object changes, energy is transferred to or from an object.

Middle School Engineering Design

MS. Engineering Design

MS-ETS 1-1. - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS 1-2. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS 1-3. - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS 1-4. - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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 6.2 - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Writing. Grade 7.2 - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Writing. Grade 8.2 - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

K-12 Computer Science Framework

6-8 Algorithms and Programming

Algorithms - Algorithms affect how people interact with computers and the way computers respond. People design algorithms that are generalizable to many situations. Algorithms that are readable are easier to follow, test, and debug.

Program Development - People design meaningful solutions for others by defining a problem's criteria and constraints, carefully considering the diverse needs and wants of the community, and testing whether criteria and constraints were met.