

2013 NATIONAL SCIENCE OLYMPIAD
AND
NATIONAL SCIENCE STANDARDS ALIGNMENT

C (SENIOR HIGH SCHOOL) DIVISION

Anatomy and Physiology – This event encompasses the anatomy and physiology of selected body systems, this year limited to neurons, excretory, and digestive systems.

M.C.1.e – H.F.1.b-c

C. Life Science – *Life science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

M.C.1 Structure and function in living systems

- e. The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.

F. Science in Personal and Social Perspectives – *A personal and social perceive of science helps a student to understand and act on personal and social issues. This perspective builds a foundation for future decision making.*

H.F.1 Personal and community health

- b. The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.
- c. Personal choice concerning fitness and health involves multiple factors. Personal goals, peer and social pressures, ethnic and religious beliefs, and understanding of biological consequences can all influence decisions about health practices.

Astronomy – Students will demonstrate an understanding of the basic concepts of math and physics relating to stellar evolution and Type Ia supernova.

H.D.4.a-c

D. Earth and Space Science – *Earth and space science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

H.D.4 Origin and evolution of the universe

- a. The origin of the universe remains one of the greatest questions in science. The "big bang" theory places the origin between 10 and 20 billion years ago, when the universe began in a hot dense state; according to this theory, the universe has been expanding ever since.
- b. Early in the history of the universe, matter, primarily the light atoms hydrogen and helium, clumped together by gravitational attraction to form countless trillions of stars. Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe.
- c. Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.

Booilever – Students will design and build the most efficient booilever.

H.E.1.b-d

E. Science and Technology – *An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.*

H.E.1 Abilities of technological design

- b. Propose designs and choose between alternative solutions.
- c. Implement a proposed solution.
- d. Evaluate the solution and its consequences.

Chem Lab – Students will demonstrate chemistry laboratory skills related to periodicity and oxidation/reduction.

H.B.2.b – H.B.3.a-e

B. Physical Science – Physical science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.

H.B.2 Structure and properties of matter

b. An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies.

H.B.3 Chemical reactions

a. Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.

b. Chemical reactions may release or consume energy. Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.

c. A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.

d. Chemical reactions can take place in time periods ranging from the few femtoseconds (10⁻¹⁵ seconds) required for an atom to move a fraction of a chemical bond distance to geologic time scales of billions of years. Reaction rates depend on how often the reacting atoms and molecules encounter one another, on the temperature, and on the properties—including shape—of the reacting species.

e. Catalysts, such as metal surfaces, accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes.

Circuit Lab – Students will compete in activities involving knowledge of direct current (DC) Electrical Circuits. The event may include hands-on experimentation and/or problem solving. Students may use nonprogrammable calculators.

H.U.2.a-c

U. Unifying Concepts and Processes – Unifying concepts and processes help students think about and integrate a range of basic ideas which builds an understanding of the natural world.

H.U.2 Evidence, models, and explanation

a. Evidence—Evidence consists of observations and data on which to base scientific explanations. The goal is to help students use evidence to understand interactions and predict changes.

b. Models—Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power. The goal is to help students learn how to make and use many models, including physical objects, plans, mental constructs, mathematical equations, and computer simulations.

c. Explanations—Explanations provide interpretation, meaning, or sense to objects, organisms, or events. Explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements, such as hypotheses, laws, principles, and theories. The goal is to help students create explanations which incorporate a scientific knowledge base, logic, and higher levels of analysis.

Designer Genes – Students will solve problems using Molecular Genetics and Biotechnology

H.C.2.a-c

C. Life Science – Life science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.

H.C.2 Molecular basis of heredity

a. In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, G, C, and T). The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism). Each DNA molecule in a cell forms a single chromosome.

- b. Most of the cells in a human contain two copies of each of 22 different chromosomes. In addition, there is a pair of chromosomes that determines sex: a female contains two X chromosomes and a male contains one X and one Y chromosome. Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each chromosome pair. An egg and a sperm unite to form a new individual. The fact that the human body is formed from cells that contain two copies of each chromosome—and therefore two copies of each gene—explains many features of human heredity, such as how variations that are hidden in one generation can be expressed in the next.
- c. Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others can change cells and organisms. Only mutations in germ cells can create the variation that changes an organism's offspring.

Disease Detectives – This event requires students to apply principles of epidemiology to real-life health situation or problem with a focus on environmental quality.

H.F.1.b-c, e – H.G.1.c

F. Science in Personal and Social Perspectives – A personal and social perceive of science helps a student to understand and act on personal and social issues. This perspective builds a foundation for future decision making.

H.F.1 Personal and community health

- b. The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.
- c. Personal choice concerning fitness and health involves multiple factors. Personal goals, peer and social pressures, ethnic and religious beliefs, and understanding of biological consequences can all influence decisions about health practices.
- e. Selection of foods and eating patterns determine nutritional balance. Nutritional balance has a direct effect on growth and development and personal well-being. Personal and social factors—such as habits, family income, ethnic heritage, body size, advertising, and peer pressure—influence nutritional choices.

G. History and Nature of Science – The history and nature of science illustrates different aspects of scientific inquiry, the human aspects of science, and the role that science has played in the development of various cultures.

H.G.1 Science as a human endeavor

- c. Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world. Science is not separate from society but rather science is a part of society.

Dynamic Planet – Students will work at stations that display a variety of Earth science materials related to Earth's glaciation and long-term climate change.

M.D.1.f-i

D. Earth and Space Science – Earth and space science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.

M.D.1 Structure of the Earth system

- f. Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the Earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- g. Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.
- h. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.
- i. Clouds, formed by the condensation of water vapor, affect weather and climate.

Elastic Launched Glider – Students will build a glider to achieve the maximum time aloft

H.E.1.b-d

E. Science and Technology – *An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.*

- H.E.1 Abilities of technological design
- Propose designs and choose between alternative solutions.
 - Implement a proposed solution.
 - Evaluate the solution and its consequences.

Experimental Design – Given a set of objects, students will design, conduct, analyze, and write-up an experiment.

H.A.1.a-f

A. Science as Inquiry – *Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.*

- H.A.1 Abilities necessary to do scientific inquiry
- Identify questions and concepts that guide scientific investigations.
 - Design and conduct scientific investigations.
 - Use technology and mathematics to improve investigations and communications.
 - Formulate and revise scientific explanations and models using logic and evidence.
 - Recognize and analyze alternative explanations and models.
 - Communicate and defend a scientific argument.

Fermi Questions – Students will estimate quantities which are difficult or impossible to measure directly.

H.A.1.c-d

A. Science as Inquiry – *Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.*

- H.A.1 Abilities necessary to do scientific inquiry
- Use technology and mathematics to improve investigations and communications.
 - Formulate and revise scientific explanations and models using logic and evidence.

Forensics – Students will identify polymers, solids, fibers, and other materials in a crime scenario.

H.A.1.c-d, f – H.U.2.a, c

A. Science as Inquiry – *Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.*

- H.A.1 Abilities necessary to do scientific inquiry
- Use technology and mathematics to improve investigations and communications.
 - Formulate and revise scientific explanations and models using logic and evidence.
 - Communicate and defend a scientific argument.

U. Unifying Concepts and Processes – *Unifying concepts and processes help students think about and integrate a range of basic ideas which builds an understanding of the natural world.*

- H.U.2 Evidence, models, and explanation
- Evidence—Evidence consists of observations and data on which to base scientific explanations. The goal is to help students use evidence to understand interactions and predict changes.
 - Explanations—Explanations provide interpretation, meaning, or sense to objects, organisms, or events. Explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements, such as hypotheses, laws, principles, and theories. The goal is to help students create explanations which incorporate a scientific knowledge base, logic, and higher levels of analysis.

Forestry – This event will test knowledge of North American trees on the official list.

H.C.3.e

C. Life Science – *Life science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

H.C.3 Biological evolution

- e. Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships. Species is the most fundamental unit of classification.

Gravity Vehicle – Students will design, build, and test a vehicle that uses gravitational potential energy as the sole propulsion energy source to reach a target point.

H.E.1.b-d

E. Science and Technology – *An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.*

H.E.1 Abilities of technological design

- b. Propose designs and choose between alternative solutions.
- c. Implement a proposed solution.
- d. Evaluate the solution and its consequences.

MagLev – Students will construct two self-propelled magnetically-levitated vehicles which will move down a magnetic track.

H.E.1.b-d

E. Science and Technology – *An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.*

H.E.1 Abilities of technological design

- b. Propose designs and choose between alternative solutions.
- c. Implement a proposed solution.
- d. Evaluate the solution and its consequences.

Materials Science – Students will answer questions or complete talks involving the science process of chemistry focused in the areas of Materials Science.

H.B.2.a, c-d – H.B.6.d

B. Physical Science – *Physical science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

H.B.2. Structure and properties of matter

- a. Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus. These outer electrons govern the chemical properties of the element.
- c. Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically.
- d. The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.

H.B.6. Interactions of energy and matter

- d. In some materials, such as metals, electrons flow easily, whereas in insulating materials such as glass they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures some materials become superconductors and offer no resistance to the flow of electrons.

Remote Sensing – Students use maps and remote sensing technology to complete tasks related to Earth’s hydrosphere.

H.C.4.e – H.U.2.a-c

C. Life Science – *Life science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

H.C.4 Interdependence of organisms

- e. Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

U. Unifying Concepts and Processes – *Unifying concepts and processes help students think about and integrate a range of basic ideas which builds an understanding of the natural world.*

H.U.2 Evidence, models, and explanation

- a. Evidence–Evidence consists of observations and data on which to base scientific explanations. The goal is to help students use evidence to understand interactions and predict changes.
- b. Models–Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power. The goal is to help students learn how to make and use many models, including physical objects, plans, mental constructs, mathematical equations, and computer simulations.
- c. Explanations–Explanations provide interpretation, meaning, or sense to objects, organisms, or events. Explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements, such as hypotheses, laws, principles, and theories. The goal is to help students create explanations which incorporate a scientific knowledge base, logic, and higher levels of analysis.

Robot Arm – Students will design and construct a robot that will move items.

H.E.1.b-d

E. Science and Technology – *An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.*

H.E.1 Abilities of technological design

- b. Propose designs and choose between alternative solutions.
- c. Implement a proposed solution.
- d. Evaluate the solution and its consequences.

Rocks and Minerals – Students will identify, describe, and classify various specimens.

M.D.2.1.d

D. Earth and Space Science – *Earth and space science focuses on science facts, concepts, principles, theories, and models that are important for all students to know, understand, and use.*

M.D.1 Structure of the Earth system

- d. Some changes in the solid Earth can be described as the "rock cycle." Old rocks at the Earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

Tech Problem Solving – Students will gather and process data to solve problems.

H.A.1.c-f

A. Science as Inquiry – *Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.*

H.A.1 Abilities necessary to do scientific inquiry

- c. Use technology and mathematics to improve investigations and communications.
- d. Formulate and revise scientific explanations and models using logic and evidence.
- e. Recognize and analyze alternative explanations and models.
- f. Communicate and defend a scientific argument.

Thermodynamics – Students will design and build a device to retain heat.

M.E.1.b-e

E. Science and Technology – An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.

M.E.1 Abilities of technological design

- b. Design a solution or product.
- c. Implement a proposed design.
- d. Evaluate completed technological designs or products.
- e. Communicate the process of technological design.

Water Quality – Students will evaluate aquatic environments.

H.A.1.c-d

A. Science as Inquiry – Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.

H.A.1 Abilities necessary to do scientific inquiry

- c. Use technology and mathematics to improve investigations and communications.
- d. Formulate and revise scientific explanations and models using logic and evidence.

Write It/Do It – A technical writing exercise where students write a description of a contraption and other students will attempt to recreate it using only the written description.

H.E.1.e

E. Science and Technology – An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.

H.E.1 Abilities of technological design

- e. Communicate the problem, process, and solution.