

National Science Education Standards Objectives Satisfied by Each Deliverable in the Competition Grades 5-8	Computer Design	Essay*	Physical Model	Model Shipping	Verbal Presentation
<b><u>Science as Inquiry</u></b> <b>CONTENT STANDARD A</b>					
<b><i>ABILITIES NECESSARY TO DO SCIENTIFIC INQUIRY</i></b>					
Identify questions that can be answered through scientific investigations.	X	X	X	X	X
Design and conduct a scientific investigation.	X	X	X	X	
Use appropriate tools and techniques to gather analyze, and interpret data.	X	X	X	X	
Develop descriptions, explanations, predictions, and models using evidence.	X	X	X	X	X
Think critically and logically to make the relationships between evidence and explanations.	X	X			X
Recognize and analyze alternate explanations and predictions.	X	X	X	X	X
Communicate scientific procedures and explanations.					X
Use mathematics in all aspects of scientific inquiry.	X	X	X	X	X
<b><i>UNDERSTANDINGS ABOUT SCIENTIFIC INQUIRY</i></b>					
Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects an phenomena; and some involve making models.	X	X	X	X	
Current scientific knowledge and understanding guide scientific investigations. Different scientific domains employ different methods, core theories, and standards to advance scientific knowledge and understanding.	X	X	X		X
Mathematics is important in all aspects of scientific inquiry.	X	X	X	X	X
Technology used to gather data enhances accuracy and allows scientists to	X	X	X		X

analyze and quantify results of investigations					
Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances.	X	X	X		X
Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry. Scientists Evaluate the explanations proposed by other scientists by examining evidence, comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations.	X	X			X
Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations.	X	X	X		X
<b><u>Physical Science</u></b>					
<b>CONTENT STANDARD B</b>					
<b><i>PROPERTIES AND CHANGES OF PROPERTIES IN MATTER</i></b>					
A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.	(depth will vary with each team)				
Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group.	(depth will vary with each team)				

Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.	(depth will vary with each team)
<b><i>MOTIONS AND FORCES</i></b>	
The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.	(depth will vary with each team)
An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.	(depth will vary with each team)
If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.	(depth will vary with each team)
<b><i>TRANSFER OF ENERGY</i></b>	
Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.	(depth will vary with each team)
Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.	(depth will vary with each team)
Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object—emitted by or scattered from it—must enter the eye.	(depth will vary with each team)
Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced. (depth will vary with each team) (depth will vary with each team) (depth will vary with each team) (depth will vary with each team) (depth will vary with each team)	(depth will vary with each team)

In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.	(depth will vary with each team)
The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.	(depth will vary with each team)
<b><u>Life Science</u></b> <b>CONTENT STANDARD C</b>	
<b><i>STRUCTURE AND FUNCTION IN LIVING SYSTEMS</i></b>	
Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.	(depth will vary with each team)
All organisms are composed of cells--the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular.	(depth will vary with each team)
Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.	(depth will vary with each team)
Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.	(depth will vary with each team)

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.	(depth will vary with each team)
Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system. Others are the result of damage by infection by other organisms.	(depth will vary with each team)
<b><i>REPRODUCTION AND HEREDITY</i></b>	
Reproduction is a characteristic of all living systems; because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually. Other organisms reproduce sexually.	(depth will vary with each team)
In many species, including humans, females produce eggs and males produce sperm. Plants also reproduce sexually--the egg and sperm are produced in the flowers of flowering plants. An egg and sperm unite to begin development of a new individual. That new individual receives genetic information from its mother (via the egg) and its father (via the sperm). Sexually produced offspring never are identical to either of their parents.	(depth will vary with each team)
Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another	(depth will vary with each team)
Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes.	(depth will vary with each team)
The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.	(depth will vary with each team)

<b><i>REGULATION AND BEHAVIOR</i></b>					
All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.	(depth will vary with each team)				
Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.	(depth will vary with each team)				
Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.	(depth will vary with each team)				
An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history.	(depth will vary with each team)				
<b><i>POPULATIONS AND ECOSYSTEMS</i></b>					
A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.	X	X	X		X
Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers--they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.	X	X	X		X
For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy		X	X		X

through photosynthesis. That energy then passes from organism to organism in food webs.					
The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.	X	X	X		X
<b><i>DIVERSITY AND ADAPTATIONS OF ORGANISMS</i></b>					
Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.	(depth will vary with each team)				
Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.	(depth will vary with each team)				
Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.	(depth will vary with each team)				

## **Earth and Space Science**

### **CONTENT STANDARD D:**

#### ***STRUCTURE OF THE EARTH SYSTEM***

The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.	(depth will vary with each team)
Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions	(depth will vary with each team)
Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.	(depth will vary with each team)
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.	(depth will vary with each team)
Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.	(depth will vary with each team)
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.	(depth will vary with each team)
Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.	(depth will vary with each team)

The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.	(depth will vary with each team)
Clouds, formed by the condensation of water vapor, affect weather and climate.	(depth will vary with each team)
Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.	(depth will vary with each team)
Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks.	(depth will vary with each team)
<b><i>EARTH'S HISTORY</i></b>	
The earth processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. earth history is also influenced by occasional catastrophes, such as the impact of an asteroid or comet.	(depth will vary with each team)
Fossils provide important evidence of how life and environmental conditions have changed.	(depth will vary with each team)
<b><i>EARTH IN THE SOLAR SYSTEM</i></b>	
The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system.	(depth will vary with each team)
Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.	(depth will vary with each team)

Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the earth's surface and explains the phenomena of the tides.	(depth will vary with each team)				
The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.	(depth will vary with each team)				
<b><u>Science and Technology</u></b>					
<b>CONTENT STANDARD E:</b>					
<b><i>ABILITIES OF TECHNOLOGICAL DESIGN</i></b>					
Identify appropriate problems for technological design.	X	X	X	X	
Design a solution or product.	X	X	X	X	
Evaluate completed technological designs or products.	X	X	X	X	
Communicate the process of technological design.		X			X
<b><i>UNDERSTANDINGS ABOUT SCIENCE AND TECHNOLOGY</i></b>					
Scientific inquiry and technological design have similarities and differences. Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs, and aspirations. Technological solutions are temporary; technologies exist within nature and so they cannot contravene physical or biological principles; technological solutions have side effects; and technologies cost, carry risks, and provide benefits.	X	X	X		X
Many different people in different cultures have made and continue to make contributions to science and technology.		X			
Science and technology are reciprocal. Science helps drive technology as it addresses questions that demand more sophisticated instruments and	X	X	X		X

provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.					
Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risk often results in new technology.	X	X	X	X	X
Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protection, human safety, and aesthetics.	X	X	X	X	X
Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot.	X		X	X	
<b><u>Science in Personal and Social Perspectives</u></b>					
<b>CONTENT STANDARD F:</b>					
<b><i>PERSONAL HEALTH</i></b>					
Regular exercise is important to the maintenance and improvement of health. The benefits of physical fitness include maintaining healthy weight, having energy and strength for routine activities, good muscle tone, bone strength, strong heart/lung systems, and improved mental health. Personal exercise, especially developing cardiovascular endurance, is the foundation of physical fitness.	(depth will vary with each team)				
The potential for accidents and the existence of hazards imposes the need for injury prevention. Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions. Injury prevention has personal and social dimensions.	(depth will vary with each team)				

The use of tobacco increases the risk of illness. Students should understand the influence of short-term social and psychological factors that lead to tobacco use, and the possible long-term detrimental effects of smoking and chewing tobacco.	(depth will vary with each team)				
Alcohol and other drugs are often abused substances. Such drugs change how the body functions and can lead to addiction.	(depth will vary with each team)				
Food provides energy and nutrients for growth and development. Nutrition requirements vary with body weight, age, sex, activity, and body functioning.	(depth will vary with each team)				
Sex drive is a natural human function that requires understanding. Sex is also a prominent means of transmitting diseases. The diseases can be prevented through a variety of precautions.	(depth will vary with each team)				
Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.	(depth will vary with each team)				
<b><i>POPULATIONS, RESOURCES, AND ENVIRONMENTS</i></b>					
When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.	X	X	X	X	X
Causes of environmental degradation and resource depletion vary from region to region and from country to country.					
<b><i>NATURAL HAZARDS</i></b>					
Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids.	(depth will vary with each team)				

Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.	(depth will vary with each team)				
Natural hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.	(depth will vary with each team)				
<b><i>RISKS AND BENEFITS</i></b>					
Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.	(depth will vary with each team)				
Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).	(depth will vary with each team)				
Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.	(depth will vary with each team)				
Important personal and social decisions are made based on perceptions of benefits and risks.	(depth will vary with each team)				
<b><i>SCIENCE AND TECHNOLOGY IN SOCIETY</i></b>					
Science influences society through its knowledge and worldview.	X	X	X		X
Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the		X			X

environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.					
Societal challenges often inspire questions for scientific research, and social priorities often influence research priorities through the availability of funding for research.		X			X
Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.		X	X	X	X
Scientists and engineers work in many different settings, including colleges and universities, businesses and industries, specific research institutes, and government agencies.		X			X
Scientists and engineers have ethical codes requiring that human subjects involved with research be fully informed about risks and benefits associated with the research before the individuals choose to participate. This ethic extends to potential risks to communities and property. In short, prior knowledge and consent are required for research involving human subjects or potential damage to property.		X			X
Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.		X			X

<b><u>History and Nature of Science</u></b>					
<b>CONTENT STANDARD G:</b>					
<b><i>SCIENCE AS A HUMAN ENDEAVOR</i></b>					
Women and men of various social and ethnic backgrounds--and with diverse interests, talents, qualities, and motivations--engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others.	X	X	X	X	X
Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity--as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	X	X	X	X	X
<b><i>NATURE OF SCIENCE</i></b>					
Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.	X	X	X	X	X
In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from	X	X	X	X	X

the same data. Ideally, scientists acknowledge such conflict and work towards finding evidence that will resolve their disagreement.					
It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.	X	X	X	X	X
<b><i>HISTORY OF SCIENCE</i></b>					
Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.		X			X
In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.		X			X
Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.		X			X

\*Analysis based on previous years' essay questions