Science and Sustainability:

Correlations to the National Science Education Standards

As a complete course, *Science and Sustainability* provides approximately one school year of science instruction. To help you evaluate course content, *Science and Sustainability* activities have been correlated to the National Science Education Standards (NSES, 1996). The Standards are divided into three levels: K–4, 5–8, and 9–12. The NSES high school standards are intended to help guide instruction for the four-year period covering grades 9–12. For this reason, *Science and Sustainability* addresses many, but not all, of these standards. Other instructional materials, including those developed by SEPUP, may be used to help address these standards in their entirety. For each standard, detail is provided as to whether the concept is introduced, covered or discussed briefly, or taught to mastery.

This document contains correlations to all of the elements of the following NSES Science Content Standards: Science as Inquiry (A), Physical Science (B), Life Science (C), Earth Science (D), Science and Technology (E), Science in Personal and Social Perspectives (F), and History and Nature of Science (G). Because of the spiral nature of concept development in *Science and Sustainability*, a specific activity may not address all aspects of a standard. However, all of the activities correlated to a particular standard work together to develop student understanding and mastery of the identified content. For more information on the content of a specific activity or unit, please consult the Teacher's Guide for the content in question.

NOTE: In the following tables, *Treatment* refers to whether the Standard is covered in depth (+), covered significantly ( ), covered minimally (–), or not covered (NC).
The text for the individual Standards has been edited for space and format reasons. Please refer to the National Science Education Standards document for the complete text.

SEPUP (2001) *Science and Sustainability*. Ronkonkoma, NY: Lab-Aids®, Inc.

A: Science as Inquiry

Guide to the Content Standard		Treatment	S&S Activity
Abilities necessary to do scientific inquiry	Identify questions and concepts that guide scientific investigations.	+	1–37
	Design and conduct scientific investigations.	+	1–37
	Use technology and mathematics to improve investigations and communications.	+	1–37
	Formulate and revise scientific explanations and models using logic and evidence.	+	2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 17, 23, 24, 25, 28, 29, 31, 33, 34, 36
	Recognize and analyze alternative explanations and models.	+	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 18, 19, 22, 23, 25, 28, 29, 31, 33, 34, 37
	Communicate and defend a scientific argument.	+	1–37
Understandings about scientific inquiry	Scientists usually inquire about how physical, living, or designed systems function.	+	4, 13, 14, 16, 17, 19, 22, 24, 26, 28, 33, 35
	Scientists conduct investigations for a wide variety of reasons.	+	1–37
	Scientists rely on technology to enhance the gathering and manipulation of data.	+	1–37
	Mathematics is essential in scientific inquiry.	+	1–37
	Scientific explanations must adhere to specific criteria.	+	1–37
	Results of scientific inquiry emerge from different types of investigations and public communication among scientists.	+	1–37

B: Physical Science

Guide to the Content Standard		Treatment	S&S Activity
Structure of atoms	Matter is made of minute particles called atoms, and atoms are composed of even smaller components.	+	4, 12, 14, 15, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33
	The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons.	+	14, 34
	The nuclear forces that hold the nucleus of an atom together are usually stronger than the electric forces that would make it fly apart.	+	31, 34, 36
	Radioactive isotopes are unstable and undergo spontaneous nuclear reactions, emitting particles and/or wavelike radiation.	+	34, 36
Structure and properties of matter	Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus.	–	14, 15, 22, 23, 33
	An element is composed of a single type of atom.	+	14, 15, 22, 24, 25, 26, 33
	Bonds between atoms are created when electrons are paired up by being transferred or shared.	+	14, 15, 21, 22, 23, 24, 26, 27, 28, 31, 32, 33
	The physical properties of compounds reflect the nature of the interactions among its molecules.		4, 14, 15, 22, 23, 24, 25, 26, 27, 28, 29, 32
	Solids, liquids, and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together.		21, 22, 23, 25, 26, 28, 29, 31, 32
	Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures.	+	14, 15, 16, 21, 22, 23, 26, 28, 29, 31, 32
Chemical reactions	Chemical reactions occur all around us.	+	13, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 36
	Chemical reactions may release or consume energy.	+	1, 6, 16, 21, 22, 23, 24, 25, 28, 31, 32, 33
	A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms.	–	16, 33
	Chemical reactions can take place in time periods ranging from the few femtoseconds (10-15 seconds) to geologic time scales of billions of years.	–	3, 16, 21, 26, 27, 28, 33
	Catalysts, such as metal surfaces, accelerate chemical reactions.	+	21, 26, 33

Guide to the Content Standard		Treatment	S&S Activity
Motion and forces	Objects change their motion only when a net force is applied.		35
	Gravitation is a universal force that each mass exerts on any other mass.	NC	
	The electric force is a universal force that exists between any two charged objects.	NC	
	Between any two charged particles, electric force is vastly greater than the gravitational force.	NC	
	Electricity and magnetism are two aspects of a single electromagnetic force.	NC	
Conservation of energy and increase in disorder	The total energy of the universe is constant.		3, 4, 28
	All energy can be considered to be either kinetic energy, potential energy, or energy contained by a field.		4, 35
	Heat consists of random motion and the vibrations of atoms, molecules, and ions.	+	4, 28, 29
	Everything tends to become less organized and less orderly over time.	NC	
Interactions of energy and matter	Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.	–	34
	Electromagnetic waves result when a charged object is accelerated or decelerated.		34
	Each kind of atom or molecule can gain or lose energy only in particular discrete amounts.	–	34
	In some materials electrons flow easily, whereas in insulating materials they can hardly flow at all.	–	14

C: Life Science

Guide to the Content Standard		Treatment	S&S Activity
The cell	Cells have particular structures that underlie their functions.	+	13, 16, 17, 19
	Most cell functions involve chemical reactions.	+	3, 13, 16, 27, 28
	Cells store and use information to guide their functions.	+	13, 17, 19, 36
	Cell functions are regulated both through changes in the activity of the functions performed by proteins and through the selective expression of individual genes.		13, 19
Molecular basis of heredity	In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA.	+	13, 16
	Most of the cells in a human contain two copies of each of 22 different chromosomes.	NC	
	Changes in DNA (mutations) occur spontaneously at low rates.	NC	
Biological basis of evolution	Species evolve over time.	+	13, 16
	The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms.	NC	
	Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record as well as for the striking molecular similarities observed among the diverse species of living organisms.	NC	
	The millions of different species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors.	NC	
	Biological classifications are based on how organisms are related.	NC	
Interdependence of organisms	The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.	+	12, 22, 26
	Energy flows through ecosystems in one direction.	+	2, 11, 32
	Organisms both cooperate and compete in ecosystems.	+	2, 7, 8, 9, 10
	Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite.	+	2, 7, 8, 9, 10, 11
	Human beings live within the world's ecosystems.	+	1–37

Guide to the Content Standard		Treatment	S&S Activity
Matter energy and organization in living systems	All matter tends toward more disorganized states.	–	(implicit in several activities)
	The energy for life primarily derives from the sun.		2
	The chemical bonds of food molecules contain energy.		1, 2, 11
	The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism	NC	
	The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.	+	1, 2, 7, 8, 9, 10, 11
	As matter and energy flows through different levels of organization of living systems and between living systems and the physical environment, chemical elements are recombined in different ways.	+	2, 3, 13, 16, 27, 28
Behavior of organisms	Multicellular animals have nervous systems that generate behavior. .	NC	
	Organisms have behavioral responses to internal changes and to external stimuli.	NC	3
	Like other aspects of an organism's biology, behaviors have evolved through natural selection.	NC	
	Behavioral biology has implications for humans, as it provides links to psychology, sociology, and anthropology	–	2, 3, 7, 8

D: Earth and Space Science

Guide to the Content Standard		Treatment	S&S Activity
Energy in the earth system	Earth systems have internal and external sources of energy, both of which create heat.		31, 37
	The outward transfer of earth's internal heat drives convection circulation in the mantle that propels the plates comprising earth's surface across the face of the globe.	NC	
	Heating of earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.	NC	
	Global climate is determined by energy transfer from the sun at and near the earth's surface.	–	6
Geochemical cycles	The earth is a system containing essentially a fixed amount of each stable chemical atom or element.		6, 22
	Movement of matter between reservoirs is driven by the earth's internal and external sources of energy.	–	22
Origin and evolution of the earth system	The sun, the earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.	NC	
	Geologic time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations.	NC	
	Interactions among the solid earth, the oceans, the atmosphere, and organisms have resulted in the ongoing evolution of the earth system.	NC	
	Evidence for one-celled forms of life--the bacteria--extends back more than 3.5 billion years.	NC	
Origin and evolution of the universe	The origin of the universe remains one of the greatest questions in science.	NC	
	Early in the history of the universe, matter clumped together by gravitational attraction to form countless trillions of stars.	NC	
	Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium.		31

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E: Science and Technology

Guide to the Content Standard		Treatment	S&S Activity
Abilities of technological design	Identify a problem or design an opportunity.		5, 25, 28
	Propose designs and choose between alternative solutions.		5, 25, 28
	Implement a proposed solution.		5, 25, 28
	Evaluate the solution and its consequences.		5, 25, 28
	Communicate the problem, process, and solution.		5, 25, 28
Understandings about science and technology	Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations.	+	1–37
	Science often advances with the introduction of new technologies.	+	4, 10, 11, 16, 18, 19, 21, 24, 26, 27, 28, 29, 31, 33, 34, 36
	Creativity, imagination, and a good knowledge base are all required in the work of science and engineering	+	5, 14, 15, 16, 17, 18, 19, 20, 22, 24, 26, 27, 28, 29, 31, 32, 33, 36, 37
	Science and technology are pursued for different purposes.		Most activities
	Technological knowledge is often not made public because of patents and the financial potential of the idea or invention.		Most activities

F: Science in Personal and Social Perspectives

Guide to the Content Standard		Treatment	S&S Activity
Personal and community health	Hazards and the potential for accidents exist.	NC	
	Humans have a variety of mechanisms that can reduce and modify hazards.	+	1–37
	The severity of disease symptoms is dependent on many factors	NC	
	Personal choice concerning fitness and health involves multiple factors. .	+	11, 12, 20, 22, 25, 26, 27, 28, 29, 32, 36, 37
	An individual's mood and behavior may be modified by substances.	NC	
	Selection of foods and eating patterns determine nutritional balance.		11, 12, 14
	Families serve basic health needs, especially for young children.		
	Sexuality is basic to the physical, mental, and social development of humans.	NC	

Guide to the Content Standard		Treatment	S&S Activity
Population growth	Populations grow or decline through the combined effects of births and deaths, and through emigration and immigration.	+	2, 7, 8, 9, 10, 37
	Various factors influence birth rates and fertility rates.	+	7, 8, 9
	Populations can reach limits to growth.	+	7, 8, 9, 10, 11
Natural resources	Human populations use resources in the environment in order to maintain and improve their existence.	+	1–37 (not all explicit)
	The earth does not have infinite resources	+	1–37 (not all explicit)
	Humans use many natural systems as resources.	+	1–37 (not all explicit)
Environmental quality	Natural ecosystems provide an array of basic processes that affect humans.	+	1, 2, 6, 9, 10, 11, 12, 23, 24, 25, 37
	Materials from human societies affect both physical and chemical cycles of the earth.	+	1–37 (not all explicit)
	Many factors influence environmental quality.	+	1–37 (not all explicit)
Natural and human–induced hazards	Normal adjustments of earth may be hazardous for humans.	+	37
	Human activities can enhance potential for hazards.	+	1–37 (not all explicit)
	Some hazards are rapid and spectacular. But there are slow and progressive changes that also result in problems for individuals and societies.	+	37
	Natural and human-induced hazards present the need for humans to assess potential danger and risk.	+	1–37 (not all explicit)
Science and technology in local, national, and global challenges	Science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen.	+	1–37 (not all explicit)
	Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related challenges.	+	1–37 (not all explicit)
	Progress in science and technology can be affected by social issues and challenges.	+	1–37 (not all explicit)
	Individuals and society must decide on proposals involving new research and the introduction of new technologies into society.	+	1–37 (not all explicit)
	Humans have a major effect on other species.	+	1–37 (not all explicit)

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Guide to the Content Standard		Treatment	S&S Activity
Science as a human endeavor	Individuals and teams have contributed and will continue to contribute to the scientific enterprise.	+	2, 4, 5, 13, 14, 16, 17, 19, 24, 26, 27, 28
	Scientists have ethical traditions.		implicit in most activities
	Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world.	+	1–37
Nature of scientific knowledge	Science distinguishes itself through the use of empirical standards, logical arguments, and skepticism,	+	1–37
	Scientific explanations must meet certain criteria.	+	1–37
	All scientific ideas depend on experimental and observational confirmation.	+	1–37
Historical perspectives	In history, diverse cultures have contributed scientific knowledge and technologic inventions.		1, 4, 13, 14, 16, 17, 19, 21, 24, 26, 28
	Usually, changes in science occur as small modifications in extant knowledge.		4, 13, 16, 17, 19, 24
	Occasionally, there are advances in science and technology that have important and long-lasting effects on science and society.	+	1–37 (not all explicit)
	The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time.		4, 13, 14, 16, 17, 19, 24, 28