Lab-Aids Correlations for

NEXT GENERATION SCIENCE STANDARDS

SCIENCE AND SUSTAINABILITY

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This document is intended to show how our curriculum products align with the *Next Generation Science Standards* and Common Core documents.

ABOUT OUR PROGRAMS

Lab-Aids Core Science Programs are developed to support current knowledge on the teaching and learning of science. All materials support an inquiry-driven pedagogy, with support for literacy skill development and with assessment programs that clearly show what students know and are able to do from using the programs. All programs have extensive support for technology in the school science classrooms, and feature comprehensive teacher support. For more information please visit www.lab-aids.com and navigate to the program of interest.

SCIENCE AND SUSTAINABILITY

Science and Sustainability is a full year course in environmental or integrated science. It was developed by the Science Education for Public Understanding Program, at the Lawrence Hall of Science, at the University of California, Berkeley, and distributed nationally by LAB-AIDS, Inc. Development of SEPUP materials is supported by grants from the National Science Foundation.

Science and Sustainability Unit	Student Book Pages	Issue Focus
Living on Earth	4-127	What do humans need to survive? How do our survival needs differ from those of other organisms? In what ways are they related? Students examine the survival needs of all living organisms and investigate the roles of science and technology in human survival. Population growth, food, thermodynamics and energy are introduced as major themes of the course. The unit closes with a student debate on development in the region surrounding Beijing, China, using information obtained from Landsat imagery and other sources.
Feeding the World	132-245	How can we ensure that enough food will be available for the world's growing population? Why do we farm were we do? Students explore concepts in chemical bonding, genetics, plant biology and energy transfer within the context of food production. The unit closes with an investigation of the impact of genetic engineering on food production and biodiversity.
Using Earth's Resources	250-377	How can we improve our basic survival needs are met and what are the trade-offs involved? This section focuses on themes related to the use of materials and energy to improve quality of life and to raise the standard of living. Students identify Earth's many resources and explore the nature and environmental impact of their use by humans. Concepts related to petrochemicals, polymerization, energy from chemical reactions and catalysis are investigated. The unit closes with students examining issues and trade-offs involved with global distribution of food and oil.
Moving the World	382-474	What are the trade-offs involved with providing food and fuel to growing world? What are the trade-offs of using biomass as an energy source? Students explore the topics of mechanics, energy, nuclear chemistry, irradiation, and gas laws. Local, relevant community issues, such as water treatment methods, land use decisions, population growth and economic impact, provide the context for this unit.

ABOUT THE NEXT GENERATION SCIENCE STANDARDS

The National Academy of Sciences, Achieve, the American Association for the Advancement of Science, and the National Science Teachers Association have collaborated over several years to develop the *Next Generation Science Standards* (NGSS). The first step of the process was led by The National Academies of Science, a non-governmental organization commissioned in 1863 to advise the nation on scientific and engineering issues. On July 19, 2011, the National Research Council (NRC), the functional staffing arm of the National Academy of Sciences, released the *Framework for K-12 Science Education*.

The *Framework* was a critical first step because it is grounded in the most current research on science and science learning and it identifies the science all K–12 students should know. The second step in the process was the development of standards grounded in the NRC Framework. A group of 26 lead states and writers, in a process managed by Achieve, has been working since the release of the Framework to develop K-12 *Next Generation Science Standards*. The *Standards* have undergone numerous lead states and all state reviews as well as two public comment periods, the most recent of these in January, 2013. The final release of the Standards coincided with the National Conference of the National Science Teachers Association Annual Conference in San Antonio, TX, the week of April 8, 2013.

The *Next Generation Science Standards* (NGSS) provide an important opportunity to improve not only science education but also student achievement. Based on the *Framework for K–12 Science Education*, the NGSS are intended to reflect a new vision for American science education. *The Next Generation Science Standards* are student performance expectations – NOT curriculum. Even though within each performance expectation Science and Engineering Practices (SEP) are partnered with a particular Disciplinary Core Idea (DCI) and Crosscutting Concept (CC) in the NGSS, these intersections do not predetermine how the three are linked in curriculum, units, or lessons. Performance expectations simply clarify the expectations of what students will know and be able to do be the end of the grade or grade band.

As the reader knows, the *Standards* represent content from several domains: (1) science and engineering practices; (2) cross-cutting concepts; (3) the disciplines of life, earth, and physical science, as set forth in the *Next Generation Science Framework* (NRC, 2012). The Standards themselves are written as performance indicators, and content from the Common Core (http://www.corestandards.org/) is included. The following middle level standard from the life sciences is used to show the basic structure. Standards, as performance indicators, are in the white box on top, and the relevant Practices, Disciplinary Core Ideas, and Crosscutting Concepts are listed below in the blue, orange, and green boxes, respectively. Clarification Statements, in red, list assessment boundaries or further describe the standard; statements marked with an asterisk (*) denote integration of engineering content.

HS-PS1-1 Matter and its Interactions

Students who demonstrate understanding can:

HS-PS1-1. **Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.** [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [*Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Use a model to predict the relationships between systems or between components of a system.	**PS1.A: Structure and Properties of Matter** • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Connections to other DCIs in this grade-band:
HS.LS1.C

Articulation of DCIs across grade-bands:
MS.PS1.A ; **MS.PS1.B**

Common Core State Standards Connections:
ELA/Literacy -
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. *(HS-PS1-1)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Various other appendices describe other important elements of the Standards, such as DCI progressions, STS, nature of science, and more.

ABOUT THE LAB-AIDS CITATIONS

The following tables are presented in a Disciplinary Core Idea arrangement – Earth Space Science (ESS), Life Science (LS), Physical Science (PS) and Engineering, Technology and Applications of Science (ETS). This document is intended as a summary document to show the NGSS and Common Core ELA/Math alignment as of January 2015, and is based on input from the SEPUP staff. In addition, not all SEPUP content may appear here, as some may contain science content that falls outside NGSS specifications.

Citations included in the correlation document are as follows:

Unit title, Activity Number and Description:

NGSS Performance Expectation	HS-LS3-3
Science and Engineering Practices	Analyzing and Interpreting Data
	Developing and Using Models
	Using Mathematics and Computational Thinking
Crosscutting Concepts	Patterns
	Systems and System Models
Disciplinary Core Ideas	(ETS1.A)*
	ETS1.B
	ETS1.C
Common Core English-Language Arts	WHST.9-12.9
Common Core Mathematics	MP.2

*The use of parenthesis () indicates partial coverage.

SCIENCE AND SUSTAINABILITY

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
1 SUSTAINABLE LIVING (4 activities) Students are introduced to the global perspective of this course as they examine the possessions of families from four countries and decide which of those possessions are essential for survival. Next, students build upon this concept as they work in small groups to identify materials and supplies needed for survival in various extreme conditions. Class discussion summarizes group outcomes, organizes their ideas into categories and guides them to realize that many survival needs, although apparently quite differently, share a common theme: the transfer of energy. Survival needs and societal comforts are then related to sustainability through an exploration of energy released during the combustion of a renewable and a non-renewable fuel. Finally, students read about Rapa Nui, an island where misuse of resources precipitated a collapse of the society and a sharp decline in population.		(Using Mathematics & Computational Thinking) (Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)			ELA: RST.11-12.8 RST.11-12.1 MATH: (HSN-Q.A.1) HSA-CED.A.1
2 SURVIVAL NEEDS: FOOD (5 activities) Student are introduced to, or reacquainted, with the concept of ecosystems and the fact that chemical energy is stored in food. The transfer of energy from organism to organism and from one	(HS-LS2-3)	Using Mathematics & Computational Thinking (Constructing Explanations & Design Solutions)	Systems & Models Stability & Change	(LS2.A) (LS2.B) (LS2.C)	ELA: (WHST.11-12.8) WHST9-12.7

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
trophic level to the next is also presented. Food webs and food chains are introduced as a means of graphically representing relationships among producers and consumers. Student simulate and evaluate a method used by field biologists to estimate population size, and use their understanding of the relationships among organisms in an ecosystem to design smaller sustainable environments.		(Developing & Using Models) Asking Questions & Defining Problems Scientific Investigation Use a Variety of Methods Planning & Carrying out Investigations (Analyzing & Interpreting Data) (Obtaining, Evaluating, & Communicating Information)			MATH: HSA-CED.A.1 HSA-CED.A.4
3 SURVIVAL NEEDS: TEMPERATURE (4 activities) Students investigate the effects of temperature on yeast fermentation and related their findings to cell physiology. They are introduced to the concept of optimal temperature range for life and read about various adaptations organisms have for maintaining optimal temperature. Students develop a strong basis for understanding the concept of homeostasis and the laws of thermodynamics. The use of	(HS-PS3-1)	(Using Mathematics & Computational Thinking) (Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data)	Systems & Models Energy & Matter	(PS3.B)	ELA: RST11.12.8 WHST.9-12.2 MATH: HSA-CED.A.1 (HSN.Q.A.1)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
energy flow diagrams is introduced as a means of studying heat transfer.		(Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena)			
4 ENERGY TRANSFER (5 activities) Students measure and compare specific heat of water with the specific heat of various other materials. They also consider the effects of water's specific heat on the processes that sustain life. Students then explore the physical basis for heat as they investigate the relationships among motion, temperature and thermal energy.	(HS-PS3-1) (HS-PS3-2)	Scientific Investigation Use a Variety of Methods (Planning & Carrying out Investigations) (Using Mathematics & Computational Thinking) (Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data) (Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena)	Systems & Models Energy & Matter	(PS3.A) (PS3.B) PS3.D	ELA: RST.9-10.8 RST11.12.8 RST.11-12.1 (RST.9-10.7) (WHST.11-12.8) MATH: HSA-CED.A.1 HSA-CED.A.4 HSS-ID.A.1 (HSN.Q.A.1)
5 DESIGNING AN INSULATION SYSTEM (2 activities) Students compare the insulating ability of several substances. They use this knowledge to design, build and test the effectiveness of an insulating	(HS-PS3-1) (HS-PS3-4)	Scientific Investigation Use a Variety of Methods	Systems & Models Energy & Matter	(PS3.A) (PS3.B)	ELA: RST11-12.8 WHST.11-12.8 WHST9-12.7

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
container that can keep a liquid hot in a cold environment or cold in a hot environment. In doing so, students investigation the concepts of experimental control, technological innovation and insulation.		(Constructing Explanations & Design Solutions) Asking Questions & Defining Problems Planning & Carrying out Investigations (Analyzing & Interpreting Data) (Obtaining, Evaluating, & Communicating Information)			MATH: HSS-ID.A.1 (HSN.Q.A.1)
6 LIVING IN TODAY'S WORLD (3 activities) Students use statistical information from *Material World* to investigate various countries use of materials and energy. Students also make inferences about the obstacles to survival in each country, and how each country uses technology to overcome those obstacles.	(HS-ESS2-4) (HS-ESS3-4)	(Analyzing & Interpreting Data) (Engaged in Argument from Evidence)	(Influence of Engineering, Technology, & Science on Society & the Natural World)	(ESS2.D)	ELA: (RST.11-12.8) MATH: HSS-ID.A.1 (HSN.Q.A.1)
7 MODELING HUMAN POPULATION GROWTH (4 activities) Students are introduced to different types of scientific models and their uses. They examine the growth of the world's human population over time, leading to discussion about changes in population	(HS-LS2-1)	(Developing & Using Models) (Analyzing & Interpreting Data)	Systems & Models	(LS2.A) (LS2.C)	ELA: (RST.9-10.7) (RST.11-12.8) MATH:

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
and implications for the future. Students continue to focus on the issue of population as they compare global vegetation patterns and human population density.		(Constructing Explanations & Design Solutions) (Using Mathematics & Computational Thinking)			MP.4 HSA-SSE-B.3
8 POPULATION DYNAMICS (4 activities) Students use mathematical relationship that describe changes in population sizes over time, then model a population curve by growing a population of organisms in the laboratory. Students use this data to compare their growth curve with standard population models and historic population theories, such as that of Malthus. They also investigate the impact of a variety of factors, such as predators, food supply and available land, on population growth.	(HS-LS2-1)	(Analyzing & Interpreting Data) (Developing & Using Models) (Constructing Explanations & Design Solutions)	Systems & Models	(LS2.A) (LS2.C)	ELA: (RST.11-12.8) MATH: HSS-ID.A.1 (HSN.Q.A.1) HSA-SSE.B.3 MP.4
9 CHANGING POPULATION (4 activities) Students investigate how changes in birth or death rate affect population growth, then examine the relationships between population growth rates and a variety of other statistics. They also compare the population growth rates for two countries in different stages of economic develop and are introduced to the theory of demographic transition. Students evaluate whether this information could be used to address global problems as they explore	(HS-LS2-1)	(Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data) (Science Models, Laws, Mechanisms, & Theories		(LS2.A) (LS2.C)	ELA: (RST.11-12.8) (SL.11-12.8) WHST.11-12.8 WHST.9-12.2 MATH: HSS-ID.A.1 (HSN.Q.A.1)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
LIVING ON EARTH					
the concept of standard of living and its relationship to sustainability and the quality of life.		Explain Natural Phenomena)			
10 PROVIDING FOR THE POPULATION (3 activities) Students apply the concept of sustainable development to land-use decisions in a metropolitan area by examining satellite images of Beijing, China. As they explore these images, students begin to understand the ways the land near Beijing is used. Students then consider a relatively little used pieces of land and decide how it should be used in the future.	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-2) (HS-ETS1-3)	(Constructing Explanations & Design Solutions) (Asking Questions & Defining Problems) (Engaged in Argument from Evidence)	(Influence of Engineering, Technology & Science on Society & the Natural World) Science is a Human Endeavor (Science Addresses Questions about the Natural & Material World)	(LS4.D) (ESS3.C) (ETS1.A) (ETS1.B)	ELA: WHST9-12.7 WHST11-12.8 (WHST.9-12.2) (RST.11-12.7) SL.11-12.4 SL.11-12.5 MATH: HSA-SSE.B.3

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
FEEDING THE WORLD					
11 FOOD PRODUCTION (4 activities) Students identify the key factors that control human population size as they continue to develop their understanding of the concept of carrying capacity. They focus on the limiting effect of food availability and the steps humans have taken to modify world food production. Students brainstorm factors common to growing of crops, prioritizing those that maximize food production. Students design an experiment using radishes to test the effects of different population densities and/or different fertilizer concentrations on the yield of a food crop. Students also examine how information contained in satellite images can play a role in addressing scientific and decision-making issues related to food production. Finally, students investigate eating patterns around the world in an effort to determine which are most likely to promote sustainability.	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-1)	Scientific Investigation Use a Variety of Methods Planning & Carrying out Investigations (Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Cause & Effect (Science Addresses Questions about the Natural & Material World)	(LS2.C) (ESS3.C) (ETS1.A) (ETS1.B)	ELA: WHST.9-12.2 (WHST-9.12.7) RST.11-12.8 MATH: HSA-CED.A.1
12 NECESSARY NUTRIENTS (4 activities) Students have been investigating the effects of soil nutrients on plant growth and they begin this set of activities by observing the chemical properties of soil and move toward observing its physical properties. Nitrogen is measured and its relationship to plant growth and soil fertility is examined. Students learn about nutrient cycles and some of the nutrient exchange pathways essential to life on earth. The	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-3)	(Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Cause and Effect	(LS2.C) (ESS3.C) (ETS1.A) (ETS1.B)	ELA: (RST.11-12.1) (RST.11-12.8) (WSHT.9-12.9)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
FEEDING THE WORLD					
role of fertilizer as a means of correcting nutrient deficiency and the effect of excess nutrients in an ecosystem are examined.					
13 CELL STRUCTURE AND FUNCTION (4 activities) Students examine the relationship between nutritional needs and cell physiology. Using a microscope and stains students observe plant and animal cells as well as various organelles. Following their observations, students read about the structure and function of these organelles. They, then, use plastic membranes to simulate the role of the cell membrane in regulating the passage of water and other substances into and out of the cell.	(HS-LS1-2)	(Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena) (Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions) (Developing & Using Models)	Systems & System Models	(LSA1.A)	ELA: (RST.11-12.1) (RST.11-12.8) (WSHT.9-12.9)
14 EARTH'S COMPONENTS (4 activities) Students investigate how physical properties can be used to differentiate elements. They review the Periodic Table of Elements and discover that its organization reflects patterns of physical and chemical properties among the elements. Students also examine the relationship between atomic mass and specific heat.	(HS-PS1-1) (HS-PS2-6)	Planning & Carrying out Investigations (Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Patterns Scientific Knowledge Assumes an Order & Consistency in Natural Systems	(PS1.A)	ELA: RST.9-10.8 (WSHT.9-12.9) MATH: (HSN-Q.A.1)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
FEEDING THE WORLD					
		(Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena)			
15 CLASSIFYING ELEMENTS (4 activities) Students use physical and conceptual models to investigate atoms, elements, molecules, and compounds. They continue their exploration of the organization scheme of the Periodic Table and use it to predict chemical formulas. Students also use models to simulate chemical reactions.	HS-PS1-1	(Constructing Explanations & Design Solutions) (Developing & Using Models)	Patterns Scientific Knowledge Assumes an Order & Consistency in Natural Systems	(PS1.A) (PS1.B)	ELA: RST.9-10.7
16 PHOTOSYNTHESIS (3 activities) Students revisit plant growth by investigating how food and oxygen are produced during photosynthesis. They conduct an experiment to gather evidence of photosynthesis and aerobic respiration in plants. A reading on historical investigations in botany describes some of the experimental evidence that has contributed to our understanding of photosynthesis. Using a microscope, students examine chloroplasts in the leaves of *Elodea.*	(HS-LS1-5) (HS-LS2-3)	(Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Systems & Models	(LS1.A) (LS1.C) (LS2.B)	ELA: RST.9-10.7 (RST.11.12.8) WSHT.9-12.9

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
FEEDING THE WORLD					
17 PLANTS GENETICS AND THE GREEN REVOLUTION (4 activities) Students are introduced to the basic concepts of genetics as they model patterns of inheritance in corn and rice. Students review major world food crops and read about the roles of crops in feeding the world's population. The history, present efforts, and future outlook for the cultivation of rice provide as an example of past progress and current research directions in plant breeding.	(HS-LS3-1) (HS-ETS1-1)	(Developing & Using Models) (Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Science is a Human Endeavor Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(LS3.A) (ETS1.B)	ELA: RST.9-10.7 (RST.11-12.8) WSHT.9-12.9 MATH: HSA-SSE.8.3
18 BREEDING IMPROVED CROPS (4 activities) Students continue to build their understanding of the role of genetics in breeding for desired traits. They investigate the outcomes of crosses for multiple unlinked genetic traits and investigate the use of classic breeding techniques to develop new varieties of crop plants and farm animals that would be unlikely to arise through natural selection.	(HS-LS3-1) (HS-ETS1-1)	(Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions)	Science is a Human Endeavor Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(LS3.A) (ETS1.B)	ELA: RST.9-10.7 (RST.11-12.8) (WSHT.9-12.7) WSHT.9-12.9 MATH: HSA-SSE.8.3

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
FEEDING THE WORLD					
19 GENETICALLY ENGINEERING FOOD (3 activities) Students explore the relationship between genetic traits, genes, chromosomes, and DNA. They build models of nucleotides and DNA and investigate genetic engineering of rice for blight resistance. Students also contrast genetic engineering with conventional selective breeding methods.	(HS-LS3-1) (HS-ETS1-3)	(Developing & Using Models)	Science is a Human Endeavor Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(LS1.A) (LS3.A) (ETS1.A) (ETS1.B)	ELA: RST.9-10.7 WSHT.9-12.9 (WSHT.11-12.8)
20 THE ROLE OF CLONING IN FOOD PRODUCTION (1 activity) Students research a topic involving the use of cloning technologies and genetic engineering in food production efforts. Using their research results, they began to develop an understanding of the issues surrounding genetic engineering and its use in solving the problem of feeding all of the world's people. Students are then asked to present their evidence and make an informed choice about whether society should engage in continued research of genetic engineering and cloning techniques for the purposes of increasing food production.	(HS-ETS1-3)	(Constructing Explanations & Design Solutions) (Engaged in Argument from Evidence)	(Influence of Engineering, Technology & Science on Society & the Natural World)	(ETS1.A) (ETS1.B)	ELA: RST.11-12.1 RST.11-12.7 WHST.9.12.2 (WHST.11-12.8) SL.11-12.4

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
21 IDENTIFYING AND SEPARATING HYDROCARBONS (3 activities) Students begin their exploration of hydrocarbons by differentiated several liquids by comparing their chemical and physical properties. They then examine the process of distillation by distilling a mixture of three liquids that simulate crude oil and determining the properties of each fraction. Students also explore the history of petroleum use and discuss the trade-offs involved in making decisions about our consumption of this finite, non-renewable resource.	(HS-ESS3-4)	(Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data)	(Influence of Engineering, Technology & Science on Society & the Natural World) Science is a Human Endeavor	(ESS3.A) (ESS3.C)	ELA: WSHT.9-12.9 (RST.11-12.8) MATH: HSA-SSE.A.1 MP.2
22 THE CHEMISTRY OF HYDROCARBONS (3 activities) Students focus on the bonding properties of various elements – particularly carbon. They build on their understanding of structural formulas as introduced in the previous unit. As students become more familiar with chemical formulas, they see more clearly how these formulas can be used to write chemical equations. This series of activities, with its focus on the chemical structure of hydrocarbons, also introduces organic chemistry.	(HS-LS1-6)	(Developing & Using Models) (Scientific Investigations Use a Variety of Methods)	Systems & Models Structure & Function	(LS1.C)	ELA: WSHT.9-12.9
23 CLOTHING MATERIALS (5 activities) Students use the *Material World* to investigate polymer materials, particularly those used for clothing, and the properties that make them useful. Students related the	(HS-ETS1-2)	(Obtaining, Evaluating & Communicating Information)	(Influence of Engineering, Technology & Science on	ETS1.C	ELA: RST.9.10.7 (WHST.9-12.7) WHST.11-12.8)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
molecular structure of a polymer to its macroscopic behavior. They are introduced to the vast number of organic polymers – both natural and synthetic. Students learn it is possible to design and synthesize polymers for very specific applications.		(Developing & Using Models) (Asking Questions & Defining Problems)	Society & the Natural World)		SL.11-12.4
24 MATERIAL RESOURCES: METALS (3 activities) Students examine the recovery and processing of natural materials by extracting copper from malachite ore. They discuss how copper and other raw materials contribute to our highly technological lifestyle and how the by-products of ore processing can become potential toxic wastes. Students use the *Material World* to examine how other countries use natural resources and explore the environmental impact of personal and governmental decisions regarding resource use.	(HS-ESS3-4) (HS-ETS1-1)	(Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking) (Asking Questions & Defining Problems)	Cause & Effect Science is a Human Endeavor (Influence of Engineering, Technology & Science on Society & the Natural World) (Science Addresses Questions about the Natural & Material World)	(ESS3.A) (ETS1.A)	ELA: (RST.11-12.8) WSHT.9-12.9 MATH: HSA-CED.A.1
25 BY-PRODUCTS OF MATERIAL PRODUCTION (3 activities) Students investigate and evaluate a process for disposing of heavy metal waste, using the waste copper sulfate from the previous unit. Students are introduced	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-1)	(Analyzing & Interpreting Data)	Systems & Models	(LS4.D) (ESS3.A) (ESS3.C) ETS1.B	ELA: WSHT.9-12.9 WSHT.11-12.8 (WSHT.9-12.2)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
to a test for detecting low concentrations of copper in solution, then determine the sensitivity of the test, which is used to evaluate how well their solid, designed to preventing leaching of copper, works when subjected to conditions simulating acid rain. Students learn that different countries have different regulations concerning the disposal of toxic waste and then explore the development of the toxic waste trade.		(Constructing Explanations & Design Solutions) (Engaged in Argument from Evidence) (Obtaining, Evaluating & Communicating Information)	(Energy & Matter) Cause & Effect Science is a Human Endeavor (Influence of Engineering, Technology & Science on Society & the Natural World) (Science Addresses Questions about the Natural & Material World)		(SL11.12.5) (RST.11-12.8)
26 CATALYSTS, ENZYMES, AND REACTION RATES (4 activities) Students explore the simple catalytic breakdown of hydrogen peroxide. They compare the effectiveness of two inorganic catalysts and the organic enzymes catalase. Students also examine the biochemical basis for the effects of temperature on organisms by	(HS-PS1-5)	(Planning & Carrying out Investigations) (Analyzing & Interpreting Data)	Patterns (Scientific Knowledge Assume an Order & Consistency in Natural Systems)	(PS1.B)	ELA: WHST.9-12.2 WSHT.9-12.9 (RST.11-12.8) MATH: HSA-CED.A.1

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
investigating the effect of temperature on the function of the enzyme lactase.					
27 BREAKDOWN! (3 activities) Students explore how aspirin breaks down into two simpler compounds – salicylic acid and acetic acid. The structure of aspirin and its products of breakdown are discussed. Students use iron (III) chloride to test for the presence of salicylic acid. The concepts of degradation and decomposition are discussed as well as their relationship to the choices people make concerning the usage and disposal of a variety of everyday products.	(HS-PS1-5)	Planning & Carrying out Investigations (Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking)	Patterns (Scientific Knowledge Assume an Order & Consistency in Natural Systems)	(PS1.B)	ELA: WSHT.9-12.9 (RST.11-12.8) MATH: MP.2 HSN-Q.A.1
28 FOOD PRESERVATION (4 activities) These activities investigate some methods of reducing the amount of food lost to spoilage. Students come to the realization that growth of microorganisms is the cause of much food spoilage and investigate how variations in temperature or chemistry can limit microbe populations. The issue of choosing among food preservation options is introduced from a 20th century magazine article. Students also investigate the relationship between thermal energy and temperature during the changes of state required for refrigeration. They create a graph showing how temperature varies	(HS-ETS1-1)	Planning & Carrying Out Investigations (Constructing Explanations & Design Solutions) (Analyzing & Interpreting Data) (Scientific Investigations Use a Variety of Methods)	Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(ETS1.A) ETS.1.C	ELA: WHST.9-12.2 WHST.9-12.9 RST.11-12.8 MATH: MP.2 HSN-Q.A.1 HAS-SSE.A.1

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
with time as ice water is heated until it boils, then use the graph to estimate the heat of fusion and heat of vaporization of water. This information helps students understand the principles of operation for two food preservation technologies – iceboxes and mechanical refrigerators.					
29 REFRIGERATION TECHNOLOGY (4 activities) Students explore the temperature and volume changes associated with the compression and expansion of gases. The information gained from this unit and the previous unit is applied to the understanding of the functioning of a home refrigerator. Students analyze potential refrigerants based on their physical and chemical properties. They read about the rise and fall of chlorofluorocarbon (CFCs) refrigerants as well as the search for alternative refrigerants and refrigeration technologies. The evolving nature of technology and the potential value, trade-offs, and limitations of technological change are emphasized.	(HS-ESS3-4) (HS-ETS1-1)	(Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking) (Constructing Explanations & Design Solutions) Asking Questions & Defining Problems	Science is a Human Endeavor (Science Addresses Questions about the Natural & Material World) Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(ESS3.A) (ETS1.A) ETS1.C	ELA: WHST.9-12.9 (WHST.9-12.2) (RST.11-12.8)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
USING EARTH'S RESOURCES					
30 ECONOMY OF MATERIAL USE (3 activities) Students compare data on the production and consumption of metals in the United States and China. They use their comparisons to learn more about differences in resource use in more and less developed countries. To add to their understanding, students also read about the processes used to refine copper, lead and iron. The class considers how resources should be used	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-1)	(Analyzing & Interpreting Data) (Obtaining, Evaluating & Communicating Information) (Asking Questions & Defining Problems)	(Scale, Proportion & Quantity) Science is a Human Endeavor (Science Addresses Questions about the Natural & Material World) Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(LS4.D) (ESS3.A) (ESS3.C) ETS1.B	ELA: WHST.9-12.9 WHST.11-12.8 (WHST.9-12.7) RST.11-12.1 SL.11-12.4 (SL.11-12.5)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
MOVING THE WORLD					
31 FUELING TRADE-OFFS (3 activities) In these activities, students compare two liquid fuels – ethanol and kerosene. They determine the amount of energy generated by burning each fuel. Students examine the trade-offs involved in using each of these fuels for transportation and consider the use of other alternative energy sources. Finally, students explore combustion as a chemical reaction and perform calculations that reinforce the concept of conservation of mass during chemical reactions.	(HS-PS1-2) (HS-LS2-7) (HS-ETS1-1) (HS-ETS1-3)	Planning & Carrying Out Investigations (Scientific Investigations Use a Variety of Methods) (Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking) (Developing & Using Models)	Patterns (Energy & Matter) Systems & Models (Influence of Engineering, Technology & Science on Society & the Natural World)	(PS1.B) (LS4.D) (ETS1.A) (ETS1.B) ETS1.C	ELA: WHST.9-12.2 WHST.9.12.9 RST.9-10.7 (RST.11-12.8) MATH: HSA-CED.A.1
32 FUEL FROM FOOD (2 activities) Students ferment different plant products and compare their ethanol output. They also explore the trade-offs involved in the use of ethanol as a fuel and as a fuel additive.	(HS-LS2-7) (HS-ESS3-4) (HS-ETS1-1) (HS-ETS1-3)	(Obtaining, Evaluating & Communicating Information) (Asking Questions & Defining Problems) (Engaged in Argument from Evidence) (Constructing Explanations & Design Solutions)	(Scale, Proportion & Quantity) (Influence of Engineering, Technology & Science on Society & the Natural World)	(LS4.D) (ETS1.A) (ETS1.B) ETS1.C	ELA: WHST.9-12.9 (WHST.9-12.7) (WHST.11-12.8) (RST.11-12.8)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
MOVING THE WORLD					
			Science is a Human Endeavor (Science Addresses Questions about the Natural & Material World)		
33 EXOTHERMIC AND ENDOTHERMIC INTERACTIONS (4 activities) Chemical systems and their capacity to store and transfer energy are explored. Students are introduced to endothermic and exothermic reactions. After initial trials, students predict, and then measure and graph the amount of heat transferred when different amounts of chemicals are involved in an interaction. These experiences reinforce the concepts of transfer of energy, the laws of thermodynamics, the kinetic molecular theory of heat and the difference between heat and temperature.	(HS-PS1-4)	Planning & Carrying Out Investigations (Scientific Investigations Use a Variety of Methods) (Analyzing & Interpreting Data) (Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena) (Using Mathematics & Computational Thinking)	Patterns (Energy & Matter) (Scientific Knowledge Assume an Order & Consistency in Natural Systems)	(PS1.B)	ELA: WHST.9-12.9 (RST.9-10.7) (RST.11-12.8) MATH: (HSA-CED.A.1) (HSN-Q.A.1) HSS-ID.A.1

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
MOVING THE WORLD					
34 ENERGY FROM THE NUCLEUS (4 activities) Students are introduced to the concept of radiation and the uses of electromagnetic radiation and nuclear radiation. They explore the nature of electromagnetic radiation by observing that heat and light are two forms of energy that are transferred to and fro various materials in different ways. Quantitative relationships between the wavelength, frequency, and energy of electromagnetic waves are introduced. The use of nuclear energy, which produces high-energy electromagnetic radiation, is analyzed in a variety of applications, including electricity generation, medicine and industry.	(HS-PS4-1)	(Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking) (Constructing Explanations & Design Solutions)		(PS4.B)	ELA: WHST.9-12.9 (RST.11-12.8) MATH: HSA-SSE.A.1 (HSN-Q.A.1) HSS-ID.A.1
35 MECHANICAL ENERGY (5 activities) Students review energy transfer and investigate mechanical energy. They exert forces on objects to explore friction, mechanical advantage, efficiency and Newton's Laws of Motion. They measure the force exerted on an object and relate this force to the resulting changes in the object's motion as described by position, velocity, and acceleration. Students use their understanding of energy to assess energy choices in various countries in *Material World.*	(HS-PS2-1)	(Planning & Carrying Out Investigations) (Analyzing & Interpreting Data) (Using Mathematics & Computational Thinking) (Science Models, Laws, Mechanisms, & Theories Explain Natural Phenomena)	Patterns	(PS2.A)	ELA: WHST.9-12.2 (RST.11-12.8) MATH: MP.2 HSA-SSE.A.1 (HSN-Q.A.1) HSS-ID.A.1

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
MOVING THE WORLD					
		Planning & Carrying Out Investigations			
36 TRADE-OFFS OF ENERGY USE (5 activities) Students investigate and compare some of the risks associated with the combustion of fossil fuel and the fission of nuclear fuels. Pollutants produced by the combustion of ethanol and kerosene are compared and characterized as either particulate or gaseous. Some major constituents of air pollution are explored, and sources of local and regional air pollutants are investigated. Students study the health effects of various air pollutants and are introduced to the Pollutant Standards Index (PSI). Students also design and conduct an investigation of particulate air pollution in their local area. They then investigate some of the hazards of nuclear power, such as the high-energy radiation from nuclear fuels and the difficulties encountered in disposing of nuclear waste.	(HS-PS4-4) (HS-LS2-7) (HS-LS3-2) (HS-ESS3-4) (HS-ETS1-1)	(Analyzing & Interpreting Data) (Constructing Explanations & Design Solutions) Planning & Carrying Out Investigations (Engaging in Argument from Evidence)	(Cause & Effect) (Systems & System Models) (Scale, Proportion, & Quantity) (Energy & Matter) (Influence of Engineering, Technology & Science on Society & the Natural World) Science is a Human Endeavor	(PS4.B) (LS4.D) (LS3.B) (ESS3.A) (ESS3.C) (ETS1.A) (ETS1.B) ETS1.C	ELA: WHST.9-12.9 WHST.9-12.2 RST.9-10.7 (RST.11-12.8) MATH: (HSN-Q.A.1) HSS-ID.A.1
37 GLOBAL PERSPECTIVES ON SUSTAINABILITY (2 activities) In the final activity, students review many of the issues in Part 4 and throughout the course through a game.	(HS-LS2-7) (HS-ETS1-1) (HS-ETS1-3)	(Analyzing & Interpreting Data)	(Systems & System Models)	(LS4.D) (ETS1.A) (ETS1.B)	ELA: WHST.9-12.9 (RST.11-12.8)

SEPUP Unit: Activity	Performance Expectation	Science & Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Common Core ELA/ Mathematics
MOVING THE WORLD					
Students identify the goals of a community and each student must make decisions that affect the community's wealth, energy and material resources, air and water quality and population size. The short- and long-term consequences of each choice are identified and can be used to aid in the decision making process. AT the end of the game, students analyze their performance in terms of how well their decisions helped them achieve their goals and how their decisions affected the sustainability of their community.		(Constructing Explanations & Design Solutions)	(Scale, Proportion, & Quantity) (Influence of Engineering, Technology & Science on Society & the Natural World)	ETS1.C	MATH: (HSN-Q.A.1) HSS-ID.A.1 HSA-CED.A.1