LAB-AIDS Correlations for

OHIO'S 2018 LEARNING STANDARDS:

ENVIRONMENTAL SCIENCE

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This document is intended to show how our curriculum products align with the *Ohio 2018 Learning Standards: Environmental Science*[1].

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**	**Activities**	**Issue Focus**
Living on Earth	1-10	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	11-20	How can we ensure that enough food will be available for the world's growing population? Why do we farm were we do?

[1] http://education.ohio.gov/getattachment/Topics/Learning-in-Ohio/Science/Ohios-Learnin[...]ndards-and-MC/SciFinalStandardsMC060719.pdf.aspx?lang=en-US

Science and Sustainability Unit	Activities	Issue Focus
		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	21-30	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	31-37	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.

NATURE OF SCIENCE HIGH SCHOOL*

Nature of Science One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.		
Categories	**High School**	
Scientific Inquiry, Practice and Applications All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	• Identify questions and concepts that guide scientific investigations. • Design and conduct scientific investigations using a variety of methods and tools to collect empirical evidence, observing appropriate safety techniques. • Use technology and mathematics to improve investigations and communications. • Formulate and revise explanations and models using logic and scientific evidence (critical thinking).	SEPUP's *Science and Sustainability* is grounded in current understandings about cognitive development, the learning process, and the pedagogical methods that support construction of science knowledge. All aspects of the instructional materials— from the overall organization of the teaching–learning cycle to the design and sequencing of the activities to the detail of the

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<tr><td>Categories</td><td colspan="2">High School</td></tr>
<tr><td></td><td>• Recognize and analyze explanations and models.
• Communicate and support scientific arguments.</td><td rowspan="2">suggested teaching strategies—have been tailored to support students' learning. The activities employ varied teaching strategies and learning opportunities, move from the concrete to the more abstract, target common misconceptions, emphasize guided inquiry, and balance a strong, guided-inquiry orientation with engineering design challenges, readings, and opportunities for practice. Sustained attention is applied to processing for meaning as students are often asked to apply what they have learned in the context of sustainability. During the "getting started" phase of the SEPUP learning cycle, students review their initial ideas; in the "doing the activity" phase, students collect and analyze data and talk about their experiences with other students and the teacher. In the "analysis" phase, students reflect on what they have learned and respond to analysis questions designed to think deeper.</td></tr>
<tr><td>Science is a Way of Knowing
Science assumes the universe is a vast single system in which basic laws are consistent. Natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise and extend this knowledge.</td><td>• Various science disciplines use diverse methods to obtain evidence and do not always use the same set of procedures to obtain and analyze data (i.e., there is no one scientific method).
  • Make observations and look for patterns.
  • Determine relevant independent variables affecting observed patterns.
  • Manipulate an independent variable to affect a dependent variable.
  • Conduct an experiment with controlled variables based on a question or hypothesis.
  • Analyze data graphically and mathematically.
• Science disciplines share common rules of evidence used to evaluate explanations about natural phenomenon by using empirical standards, logical arguments and peer reviews.
  • Empirical standards include objectivity, reproducibility, and honest and ethical reporting of findings.</td></tr>
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<tr><td></td><td>• Logical arguments should be evaluated with open-mindedness, objectivity and skepticism.
• Science arguments are strengthened by multiple lines of evidence supporting a single explanation.
• The various scientific disciplines have practices, methods, and modes of thinking that are used in the process of developing new science knowledge and critiquing existing knowledge.</td><td rowspan="2">In teacher-guided discussions, students present their own ideas, listen to the ideas of other students, revise their thinking, and come to new understandings of the concepts being developed. Learning goals, assessment outcomes, and assessments are closely aligned and clearly delineated. Students are afforded multiple ways to express their understandings and level of mastery. This array of features allows students with a range of learning styles to achieve their optimal level of understanding. For all activities, the teacher edition gives detailed suggestions for teaching and assessment strategies, discusses the rationales for those strategies, and discusses possible student preconceptions. Literacy supports are embedded and use a variety of strategies to support student growth in reading comprehension,</td></tr>
<tr><td>Science is a Human Endeavor
Science has been, and continues to be, advanced by individuals of various races, genders, ethnicities, languages, abilities, family backgrounds and incomes.</td><td>• Science depends on curiosity, imagination, creativity and persistence.
• Individuals from different social, cultural, and ethnic backgrounds work as scientists and engineers.
• Science and engineering are influenced by technological advances and society; technological advances and society are influenced by science and engineering.
• Science and technology might raise ethical, social and cultural issues for which science, by itself, does not provide answers and solutions.</td></tr>
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Categories	**High School**	
Scientific Knowledge is Open to Revision in Light of New Evidence Science is not static. Science is constantly changing as we acquire more knowledge.	• Science can advance through critical thinking about existing evidence. • Science includes the process of comparing patterns of evidence with current theory. • Some science knowledge pertains to probabilities or tendencies. • Science should carefully consider and evaluate anomalies (persistent outliers) in data and evidence. • Improvements in technology allow us to gather new scientific evidence.	writing, oral presentations, and media viewing. The mixture of activity types (such as laboratory experiments, readings, data analysis, video clips, historical vignettes) provides the learner with multiple avenues to gather, analyze, and compare current data and thinking with that of the past. Through these experiences, learners have the opportunity to use data from a variety of sources to understand the changes that have occurred in scientific thinking, and how and why these changes came about. They also learn about important contributions from various cultures and are provided examples of how past and present scientific thinking and discoveries are influenced by the technology and ethics of the time period.

*Adapted from Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards

Physical Geology

COURSE CONTENT

The following information may be taught in any order; there is no ODE-recommended sequence.

CONTENT ELABORATION: EARTH SYSTEMS: INTERCONNECTED SPHERES OF EARTH

This topic builds upon both the physical science and biology courses as they relate to energy transfer and transformation, conservation of energy and matter, evolution, adaptation, biodiversity, population studies and ecosystem composition and dynamics. In grades 6-8, geologic processes, biogeochemical cycles, climate, the composition and properties of the atmosphere, lithosphere and hydrosphere (including the hydrologic cycle) are studied. In this course, the focus is on the connections and interactions between Earth's spheres (the hydrosphere, atmosphere, biosphere and lithosphere). Both natural and anthropogenic interactions are studied. This includes an understanding of causes and effects of climate, global climate (including El Niño/La Niña patterns and trends) and changes in climate through Earth's history, geologic events (e.g., volcanic activity or mass wasting) that impact Earth's spheres, biogeochemical cycles and patterns, the effect of abiotic and biotic factors within an ecosystem, and the understanding that each of Earth's spheres is part of the dynamic Earth system. Ground water and surface water velocities and patterns are included as the movement of water (either at the surface, in the atmosphere or beneath the surface) can be a mode of transmission of contamination. This builds upon previous hydrologic cycle studies in earlier grades. Geomorphology and topography are helpful in determining flow patterns and pathways for contamination.

The connections and interactions of energy and matter between Earth's spheres are researched and investigated using actual data. The emphasis is on the interconnectedness of Earth's spheres and the understanding of the complex relationships between them, including both abiotic and biotic factors. One event, such as a petroleum release or a flood, can impact each sphere. Some impacts are long-term, others are short-term and most are a combination of both long- and short-term. It is important to use real, quantifiable data to study the interactions, patterns and cycles among Earth's spheres.

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
ENV.ES.1: Biosphere	
• Evolution and adaptation in populations	Not explicitly addressed
• Biodiversity	Not explicitly addressed

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
• Ecosystems (equilibrium, species interactions, stability)	8.1, 8.2, 8.3, 8.4
• Population dynamics	8.1, 8.2, 8.3, 8.4, 8.5
ENV.ES.1: Biosphere	
• Atmospheric properties and currents	Not explicitly addressed
ENV.ES.1: Lithosphere	
• Geologic events and processes	Not explicitly addressed
ENV.ES.4: Hydrosphere	
• Oceanic currents and patterns (as they relate to climate)	Not explicitly addressed
• Surface and ground water flow patterns and movement	Not explicitly addressed
• Cryosphere	Not explicitly addressed
ENV.ES.5: Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere	
• Energy transformations on global, regional and local scales	1.3, 2.2, 2.5, 3.3, 3.4, 4.3, 4.4, 4.5, 11.4, 16.1, 16.2, 21.2, 21.3, 31.1, 31.2, 32.1, 34.1, 35.1, 35.4, 36.1, 37.1
• Biogeochemical cycles	11.1, 12.2, 12.2, 22.1, 26.3, 27.1, 27.3
• Ecosystems	2.2, 2.5, 3.2, 8.4, 24.1, 25.1, 25.2, 36.1, 36.2, 36.3, 37.1
• Weather	Not explicitly addressed
• Climate	6.2, 36.1

CONTENT ELABORATION: EARTH SYSTEMS: EARTH'S RESOURCES

This topic explores the availability of Earth's resources, extraction of the resources, contamination problems, remediation techniques and the storage/disposal of the resources or by-products. Conservation, protection and sustainability of Earth's resources are also included. This builds on energy and Earth's resources topics in grades 6-8 and chemistry and energy topics at the high school level.

To understand the effects that certain contaminants may have on the environment, scientific investigations and research should be conducted on a local, national and global level. Water, air, land and biotic field and lab sampling/testing equipment and methods are utilized with real-world application. Quantifiable field and/or lab data are used to analyze and draw conclusions regarding air, water or land quality. Examples of types of water-quality testing include: hydraulic conductivity, suspended and dissolved solids, dissolved oxygen, biochemical oxygen demand, temperature, pH, fecal coliform and macro-invertebrate studies. Wetland or woodland delineations and analysis, land use analysis and air monitoring (e.g., particulate matter sizes/amount) are all appropriate field study investigations. Comparative analysis of scientific field or lab data should be used to quantify the environmental quality or conditions. Local data can also be compared to national and international data.

The study of relevant, local problems can be a way to connect the classroom to the real world. Within Ohio, there are numerous environmental topics that can be investigated. Examples include wetland loss or mitigation, surface or ground water contamination (including sediment, chemical or thermal contamination), watershed management, acid rain, septic system or sewage overflows/failures, landfill seepage, underground storage tank/pipe releases, deforestation, invasive species, air pollution (e.g., photochemical smog or particulate matter), soil loss/erosion or acid mine drainage.
At the advanced science level, renewable and nonrenewable energy resources topics investigate the effectiveness, risk and efficiency for differing types of energy resources at a local, state, national and global level. This builds upon grades 6-8 Earth and space science and physical science at the high school level. Nuclear and geothermal energy are included in this topic.

Feasibility, availability, remediation and environmental cost are included in the extraction, storage, use and disposal of both abiotic and biotic resources. Environmental impact is evaluated as it pertains to both environmental and human risks. Examples include chemical hazards, radiation, biological hazards, toxicology and risk analysis studies. Learning about conservation and protection of the environment also requires an understanding of the existence and rationale for laws and regulations to conserve resources and reduce and/or remediate contamination, but the emphasis should be on the science behind the laws and regulations.

Relating Earth's resources to a global scale and using technology to collect global resource data for comparative classroom study is recommended. In addition, it is important to connect the industry and the scientific community to the classroom to increase the depth of understanding.

Critical thinking and problem-solving skills are important in evaluating resource use, management and conservation. New discoveries and research are important parts of this topic.

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
ENV.ER.1: Energy resources	
• Renewable and nonrenewable energy sources and efficiency	31, 32, 33.3, 34
• Alternate energy sources and efficiency	31.2, 33.3
• Resource availability	6.3, 9.4, 24.3, 30.1
• Mining and resource extraction	21, 23.3, 24.1, 24.2, 30.2
ENV.ER.2: Air and air pollution	
• Primary and secondary contaminants	6.2, 36.1, 36.2, 36.3
• Greenhouse gases	6.2
• Clean Air Act	Not explicitly addressed
ENV.ER.3: Water and water pollution	
• Potable water and water quality	(11.3), 12.1
• Hypoxia, eutrophication	Not explicitly addressed
• Clean Water Act	Not explicitly addressed
• Point source and non-point source contamination	(12.1)
ENV.ER.4: Soil and land	
• Desertification	Not explicitly addressed
• Mass movement and erosion	Not explicitly addressed
• Sediment contamination	Not explicitly addressed
• Land use and land management (including food production, agriculture and zoning)	10, 11.3
• Solid and hazardous waste	25, 31.2
ENV.ER.5: Wildlife and wilderness	

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
• Wildlife and wilderness management o Endangered species	8.3, 8.4
• Invasive Species	Not explicitly addressed
• Introduced Species	Not explicitly addressed

CONTENT ELABORATION: GLOBAL ENVIRONMENTAL PROBLEMS AND ISSUES

This topic is a culminating section that incorporates the previous topics and applies them to a global or international scale. Case studies, developing and using models, collecting and analyzing water and/or air quality data, conducting or researching population studies and methods of connecting to the real world is emphasized for this topic. Technology can be used for comparative studies to share local data internationally so that specific quantifiable data can be compared and used in understanding the impact of some of the environmental problems that exist on a global scale. Researching and investigating environmental factors on a global level contributes to the depth of understanding by applying the environmental science concepts to problem solving and design. Examples of global topics that can be explored include building water or air filtration models, investigating climate change data, monitoring endangered, introduced or invasive species and studying the environmental effects of an increasing human population. Researching contemporary discoveries, new technology and new discoveries can lead to improvement in environmental management.

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
ENV.GP.1: Human population	1.4, 2.5
ENV.GP.2: Potable water quality, use and availability	(11.3), (12.1)
ENV.GP.3: Climate change	(6.2)
ENV.GP.4: Sustainability	Throughout all
ENV.GP.5: Species depletion and extinction	(1.4), (2.4), (2.5), (7.2), (8)
ENV.GP.6: Air quality	6.2, 31.1
ENV.GP.7: Food production and availability	9.2, 11, 18.2, 18.3, 18.4, 19.3

OHIO ENVIRONMENTAL SCIENCE LEARNING STANDARDS	SEPUP *Science and Sustainability* Activities in Student Edition and Teacher Edition *(Content in parentheses may not be taught to mastery)*
ENV.GP.8: Deforestation and loss of biodiversity	Not explicitly addressed
ENV.GP.9: Waste management (solid and hazardous)	(25), (31.2)