Lab-Aids Correlations for

Minnesota Academic Standards in Science 2019

9-12 EARTH AND SPACE SCIENCES

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This document is intended to show how the EDC Earth Science materials align with the *Minnesota Academic Standards in Science – Final with Examples and Emphasis Statements*.

ABOUT OUR PROGRAMS
Lab-Aids has maintained its home offices and operations in Ronkonkoma, NY, since 1963. We provide over 200 kits and core curriculum programs to support science teaching and learning, grades K-12. All core curricula 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 as a result of program use. All programs have extensive support for technology and feature comprehensive teacher support. For more information, please visit https://www.lab-aids.com/edc.

ABOUT *EDC EARTH SCIENCE*
EDC Earth Science – Revised (EDC-R), Copyright 2021, is a full year, activity-driven high school earth science course developed by the Education Development Center (EDC), with support from the National Science Foundation, and is fully aligned to the *Next Generation Science Standards (*NRC and Lead States, 2013). *EDC Earth Science* is designed around the belief that students are capable of rigorous and in-depth explorations in science when given adequate support, structure, and motivation for learning.

EDC Earth Science features the following design components:

- In-depth treatment of content based on recommendations in NGSS and representative state frameworks
- Developmentally appropriate lessons featuring Earth Science concepts that build on previous learning and prepare students for more advanced courses
- Using historical, newsworthy, and fictionalized stories to draw students into the earth science content, to motivate them to acquire the knowledge for solving problems, and to serve as a framework around which students build conceptual understanding
- Differentiated instructional strategies and activities that help students construct meaning from their experiences and that serve as bridges between concrete and abstract thinking

- Support for developing literacy skills and the use of formative assessment techniques

Each chapter of EDC: Earth Science is a cluster of activities that addresses a specific set of concepts and skills. The amount of class time for each chapter will vary. A chapter may range from one to four weeks of classroom sessions. Not shown here are two project-oriented shorter chapters that open and close the course, which taken together require 2-4 weeks for completion. This provides up to 32 weeks of actual instructional time, plus an additional 4 weeks for assessment and related activities.

Each TE chapter provides detailed information on support for key NGSS core content, practices, cross cutting concepts, use of phenomena in EDC-R and more. For more information, visit us at www.lab-aids.com/edc.

EDC Earth Science		
Unit Title	*Core Science Content*	*Suggested Time*
1 Hydrosphere: Water in Earth's Systems	Water cycle; surface water, groundwater, assessing and protecting water supplies, Global patterns of ocean circulation; how wind and density differences drive ocean currents; global conveyor belt; El Niño	3-4 weeks
2 Atmosphere and Climate	Climate and weather; influence of latitude, atmospheric circulation, proximity to ocean, elevation, land features, and prevailing winds on regional climate, energy balance, albedo effect, greenhouse effect, carbon cycle, positive and negative feedback loops; Paleoclimatology, climate proxies, climate change in Earth's past, Milankovitch cycles, tectonic processes that influence climate, human impact on climate	5-8 weeks
3 Earth's Place in the Universe	Life and death of stars, solar nebular condensation hypothesis, Kepler's Laws, Earth's interior structure and composition, internal sources of heat energy, seismic waves, introduction to plate tectonic theory, driving forces of plate movement	3-4 weeks
4 Plate Tectonics	Transform-fault boundaries, earthquakes, physical and computer models Subduction zones, volcanoes, formation of igneous rocks, field-measurement technologies for volcano monitoring seafloor spreading, paleomagnetism, plate tectonics summary, landforms associated with plate boundaries	5-7 weeks
5 The Rock Cycle	Erosion and deposition, deltaic processes, formation of sedimentary rock, The nature of rocks and minerals, rock cycle	3-6 weeks
6 Earth's Resources	The geologic processes by which mineral ores are formed; mineral extraction and processing, fossil fuel formation, petroleum resources and exploration technologies	3-6 weeks

Substrand	Standard	Content Area	MINNESOTA 9-12 EARTH AND SPACE SCIENCES BENCHMARK	Location in EDC Earth Science Unit and title Chapter and pages
Strand: 1 Exploring phenomena or engineering problems				
1.1 Asking questions and defining problems	1.1.1 Students will be able to ask questions about aspects of the phenomena they observe, the conclusions they draw from their models or scientific investigations, each other's ideas, and the information they read.	ESS: Earth's Systems	**9E.1.1.1.1 Ask questions to clarify how seismic energy traveling through Earth's interior can provide evidence for Earth's internal structure. (P: 1, CC: 6,CI: ESS2)** *Emphasis is on how wave propagation depends on the density of the medium through which the wave travels and how seismic data is used to support the idea of a layered earth.*	Unit 3: Earth's Place in the Universe Chapter 9: 231-235
1.2 Planning and carrying out investigations	1.2.1 Students will be able to design and conduct investigations in the classroom, laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.	ESS: Earth's Systems	**9E.1.2.1.1 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. (P: 3, CC: 6, CI: ESS2)** *Emphasis is on physical and chemical investigations with water and a variety of solid materials to provide the evidence for how processes in the water cycle and rock cycle interact. Examples of physical investigations may include transportation and deposition of various sediment types and sizes, erosion of surfaces with varying amounts of soil moisture content and/or ground cover, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations may include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids). Examples specific to Minnesota may include chemical weathering of limestone to create karst topography.*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 2:24-35 Chapter 3: 58-76 Unit 2: Atmosphere and Climate Chapter 4: 99-103 Chapter 5: 116-124, 133-135 Chapter 6: 165-175
1.2 Planning and carrying out investigations	1.2.1 Students will be able to design and conduct investigations in the classroom,	ESS: Earth and Human Activity	**9E.1.2.1.2 Plan and conduct an investigation of the properties of soils to model the effects of human activity on soil resources. (P: 3, CC: 2, CI: ESS3, ETS2)** *Emphasis is on identifying variables to test, developing a workable*	Lab-Aids kit 318S - Soil Nutrients, Fertilizers, and Environmental Impact *Lab-Aids Clarification: This activity*

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	laboratory, and/or field to test students' ideas and questions, and will organize and collect data to provide evidence to support claims the students make about phenomena.		*experimental design, and identifying limitations of the data. Examples of variables may include soil type and composition (particularly those found in Minnesota), erosion rate, water infiltration rates, nutrient profiles, soil conservation practices, or specific crop requirements.*	*models the effects of human activity on soil resources but does not require students to plan and conduct the investigation. However, that could be accomplished with the kit materials, samples of local soil, and modified student instructions.*
Strand: 2 Looking at data and empirical evidence to understand phenomena or solve problems				
2.1 Analyzing and interpreting data	2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.	ESS: Earth's Place in the Universe	**9E.2.1.1.1 Analyze data to make a valid scientific claim about the way stars, over their life cycle, produce elements. (P: 4, CC: 5, CI: ESS1)** *Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.*	Unit 3: Earth's Place in the Universe Chapter 8: 200-201, Resource Supplement 8.0: Our Expanding Universe
2.1 Analyzing and interpreting data	2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.	ESS: Earth's Systems	**9E.2.1.1.2 Analyze geoscience data to make a claim that one change to the Earth's surface can create feedbacks that cause changes to other Earth systems. (P: 4, CC: 7, CI: ESS2, ETS2)** *Emphasis is on using data analysis tools and techniques in order to make valid scientific claims. Examples may include climate feedback mechanisms, such as how an increase in greenhouse gases causes a rise in global temperatures that melt glaciers and sea ice, which reduces the amount of sunlight reflected from the Earth's surface (albedo), increasing surface temperatures and further reducing the amount of ice. Examples may also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 3: 66-70, 72-76 Unit 2: Atmosphere and Climate Chapter 4: 102-106 Chapter 5: 115-135 Chapter 6: 155-164

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			increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent and longevity.	
2.1 Analyzing and interpreting data	2.1.1 Students will be able to represent observations and data in order to recognize patterns in the data, the meaning of those patterns, and possible relationships between variables.	ESS: Earth and Human Activity	**9E.2.1.1.3 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems and human infrastructure.* (P: 4, CC: 7, ESS3, ETS1)** *Examples of evidence (for both data and climate model outputs) may include precipitation and temperature and their associated impacts on sea level, glacial ice volumes, and atmosphere and ocean composition. Engineering examples may include using climate change data (rising sea levels) to evaluate the impact on the ability of sewer system to handle runoff or of existing wells to produce potable water.*	Unit 2: Atmosphere and Climate Chapter 5: Resource Supplement 5.0: Our Interconnected Planet Chapter 6: 165-178
2.2 Using mathematics and computational thinking	2.2.1 Students will be able to use mathematics to represent physical variables and their relationships; compare mathematical expressions to the real world; and engage in computational thinking as they use or develop algorithms to describe the natural or designed worlds.	ESS: Earth's Place in the Universe	**9E.2.2.1.1 Use mathematical and computational representations to predict the motion of natural and human-made objects that are in orbit in the solar system.** (P: 5, CC: 3, CI: ESS1, ETS2)** *Emphasis is on Kepler's laws of planetary motion and Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.*	Unit 3: Earth's Place in the Universe Chapter 8: 208-209
2.2 Using mathematics and computational thinking	2.2.1 Students will be able to use mathematics to represent physical variables and their relationships; compare	ESS: Earth's Systems	**9E.2.2.1.2 Develop a computational model, based on observational data, experimental evidence, and chemical theory, to describe the cycling of carbon among Earth's systems.** (P: 2, CC: 5, CI: ESS2)** *Emphasis is on quantitative modeling of carbon as it cycles through the*	Unit 2: Atmosphere and Climate Chapter 5: 124-135 Chapter 6: 160-163

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	mathematical expressions to the real world; and engage in computational thinking as they use or develop algorithms to describe the natural or designed worlds.		*ocean, air, rock (particularly limestone), soil, and organisms. Emphasis is also on using empirical evidence and scientific reasoning to inform the algorithmic thinking about the conservation and cycling of matter.*	
2.2 Using mathematics and computational thinking	2.2.1 Students will be able to use mathematics to represent physical variables and their relationships; compare mathematical expressions to the real world; and engage in computational thinking as they use or develop algorithms to describe the natural or designed worlds.	ESS: Earth and Human Activity	**9E.2.2.1.3 Develop or use an algorithmic representation, based on investigations of causes and effects in complex Earth systems, to illustrate the relationships within some part of the Earth system and how human activity might affect those relationships. (P: 5, CC: 4, CI: ESS3, ETS2)** *Emphasis is on students identifying the interacting components of a system, mathematically modeling how those factors interact and accounting for the effects of human activity on the system. Examples may include local systems in which natural and human-influenced variables impact the amount of runoff.*	Unit 2: Atmosphere and Climate Chapter 5: 127-135 Chapter 6: 165-175
Strand: 3 Developing possible explanations of phenomena or designing solutions to engineering problems				
3.1 Developing and using models	3.1.1 Students will be able to develop, revise, and use models to represent the students' understanding of phenomena or systems as they develop questions, predictions and/or explanations, and communicate ideas to others.	ESS: Earth's Place in the Universe	**9E.3.1.1.1 Develop and use a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. (P: 2, CC: 3, CI: ESS1)** *Emphasis is on showing the relationships among the fuel, products and the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach the Earth. Examples of evidence that students might use include the masses and life times of other stars, as well as the ways that the sun's radiation*	Unit 3: Earth's Place in the Universe Chapter 8: 200-203, 212-215

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			varies due to sudden solar flares, sunspot cycles, and non-cyclic variations over the centuries.	
3.1 Developing and using models	3.1.1 Students will be able to develop, revise, and use models to represent the students' understanding of phenomena or systems as they develop questions, predictions and/or explanations, and communicate ideas to others.	ESS: Earth's Systems	**9E.3.1.1.2 Develop and use a model based on evidence to explain how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. (P: 2, CC: 7, CI: ESS2)** *Emphasis is on how the appearance of land features (such as mountains, and valleys), and seafloor features (such as trenches and ridges) are a result of both constructive mechanisms (such as volcanism, and tectonic motion) and destructive mechanisms (such as weathering, and coastal erosion). Examples specific to Minnesota may include features formed relatively recently during continental glaciation and volcanic features that have long since been eroded away.*	Unit 3: Earth's Place in the Universe Chapter 9: 241-244 Unit 4: Plate Tectonics Chapter 10: 250-279; 11: 289-322 Chapter 12: 336-345, 350-352 Unit 5: The Rock Cycle Chapter 13: 363-389 Chapter 14: 415-426
3.1 Developing and using models	3.1.1 Students will be able to develop, revise, and use models to represent the students' understanding of phenomena or systems as they develop questions, predictions and/or explanations, and communicate ideas to others.	ESS: Earth's Systems	**9E.3.1.1.3 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (P: 2, CC: 4, CI: ESS2)** *Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean currents, which is constrained by the Coriolis effect and the outlines of continents. Examples of models may be diagrams, maps and globes, or digital representations.*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 3: 58-63, 66-71 Chapter 4: 94-98, 104-106
3.1 Developing and using models	3.1.1 Students will be able to develop, revise, and use models to represent the students' understanding of phenomena or systems as they develop	ESS: Earth's Systems	**9E.3.1.1.4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. (P: 2, CC: 2, CI: ESS2).** *Emphasis is on using a model to describe the mechanism for how energy flow affects changes in climate. Examples of the causes of climate change differ by timescale and may include: 1 - 10 years: large volcanic eruptions, ocean circulation; 10-100s*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 3: 66-76 Unit 2: Atmosphere and Climate Chapter 4: 94-98 Chapter 5: 115-123

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	questions, predictions and/or explanations, and communicate ideas to others.		*of years: changes in human activity, ocean circulation, solar output; 10 - 100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10 - 100s of millions of years: long term changes in atmospheric composition.*	Chapter 6: 165-178
3.2 Constructing explanation s and designing solutions	3.2.1 Students will be able to apply scientific principles and empirical evidence (primary or secondary) to explain the causes of phenomena or identify weaknesses in explanations developed by the students or others.	ESS: Earth's Place in the Universe	**9E.3.2.1.1 Construct an explanation that links astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe to the Big Bang. (P: 6, CC: 5, CI: ESS1, ETS2)** *Emphasis is on how the redshift of light from galaxies is an indication of cosmic expansion, on how the cosmic microwave background radiation is a remnant of the Big Bang, and on how the observed composition of ordinary matter, primarily found in stars and interstellar gases, matches that predicted by the Big Bang.*	Unit 3: Earth's Place in the Universe Chapter 8: 200-206, Resource Supplement 8.0: Our Expanding Universe
3.2 Constructing explanation s and designing solutions	3.2.1 Students will be able to apply scientific principles and empirical evidence (primary or secondary) to explain the causes of phenomena or identify weaknesses in explanations developed by the students or others.	ESS: Earth's Place in the Universe	**9E.3.2.1.2 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. (P: 6, CC: 7, CI: ESS1)** *Emphasis of the practice is on linking the evidence to the claims about Earth's formation. Emphasis of the core idea is on using available evidence within the solar system to reconstruct the early history of Earth. Examples of evidence include the absolute ages of ancient materials, the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.*	Unit 3: Earth's Place in the Universe Chapter 9: 195-199, 203-206 Unit 5: The Rock Cycle Chapter 14: 415-426
3.2 Constructing explanation s and designing solutions	3.2.2 Students will be able to use their understanding of scientific principles and the engineering design process to design solutions that meet	ESS: Earth and Human Activity	**9E.3.2.2.1 Evaluate or refine a technological solution to reduce the human impacts on a natural system and base the evaluations or refinements on evidence and analysis of pertinent data.* (P: 6, CC: 7, CI: ESS3, ETS1, ETS2)** *Emphasis is on prioritizing identified criteria and constraints related to social and environmental considerations. Examples of data for the impacts of human activities may include the quantities and types of*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 2: 38-40 Unit 5: The Rock Cycle Chapter 13: 387-389 Unit 6: Earth Resources

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	established criteria and constraints.*		*pollutants released into air or groundwater, changes to biomass and species diversity, or areal changes in land surface use (for surface mining, urban development, or agriculture). Examples for limiting impacts may range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).*	Chapter 16: 479-481
Strand: 4 Communicating reasons, arguments and ideas to others				
4.1 Engaging in argument from evidence	4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and present counterarguments.	ESS: Earth's Place in the Universe	**9E.4.1.1.1 Evaluate the evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. (P: 7, CC: 1, CI: ESS1)** *Emphasis is on evaluating the strengths, weaknesses and reliability of the given evidence along with its ability to support logical and reasonable arguments about the motion and age of crustal plates. Examples of evidence may include the ages of oceanic crust which increase with distance from mid-ocean ridges (a result of seafloor spreading), the ages of North American continental crust decreasing with distance away from a central ancient core (a result of past plate interactions).*	Unit 4: Plate Tectonics Chapter 10: 256-260 Chapter 12: 342-347 Unit 5: The Rock Cycle Chapter 14: 399-401, 415-426
4.1 Engaging in argument from evidence	4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and	ESS: Earth's Systems	**9E.4.1.1.2 Evaluate the evidence and reasoning for the explanatory model that Earth's interior is layered and that thermal convection drives the cycling of matter. (P: 7, CC: 5, CI: ESS2**) *Emphasis is on how plate tectonics is controlled by mantle convection (due to the outward flow of energy from the decay of radioactive isotopes and the gravitational movement of denser materials toward the interior).*	Unit 3: Earth's Place in the Universe Chapter 9: 241-244 Unit 4: Plate Tectonics Chapter 11: 317-319 Chapter 12: 342-352

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	present counterarguments.			
4.1 Engaging in argument from evidence	4.1.1 Students will be able to engage in argument from evidence for the explanations the students construct, defend and revise their interpretations when presented with new evidence, critically evaluate the scientific arguments of others, and present counterarguments.	ESS: Earth and Human Activity	**9E.4.1.1.3 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* (P: 7, CC: 5, CI: ESS3, ETS1)** *Emphasis is on the conservation, recycling, and reuse of resources (such as minerals, metals or soils) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for fracking sand, iron ore, and rare metals), and pumping (for oil and natural gas).*	Unit 6: Earth Resources Chapter 16: 482-484
4.2 Obtaining, evaluating and communicating information	4.2.1 Students will be able to read and interpret multiple sources to obtain information, evaluate the merit and validity of claims and design solutions, and communicate information, ideas, and evidence in a variety of formats.	ESS: Earth's Systems	**9E.4.2.1.1 Compare, integrate and evaluate sources of information in order to determine how specific factors, including human activity, impact the groundwater system of a region. (P: 8, CC: 2, CI: ESS2, ETS2)** *Emphasis is on the making sense of technical information presented in a variety of formats (graphs, diagrams and words). Example of sources of information may include student experimental data. Examples of factors may include porosity, permeability, sediment or rock type, recharge or discharge factors, and potential energy. Examples of human factors may include usage rates, run-off, agricultural practices, and loss of wetlands.*	Unit 1: Hydrosphere: Water in Earth's Systems Chapter 2: 28-43
4.2 Obtaining, evaluating and communicating information	4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of	ESS: Earth and Human Activity	**9E.4.2.2.1 Apply place-based evidence, including those from Minnesota American Indian Tribes and communities and other cultures, to construct an explanation of how a warming climate impacts the hydrosphere, geosphere, biosphere, or atmosphere. (P: 8, CC: 4, CI: ESS3)** *Examples of cultures may include those within the local context of the learning community and*	Unit 2: Atmosphere and Climate Chapter 5: 112-113 *This is an example from the Inupiat people of Kivalina, Alaska.*

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	Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems.		*within the context of Minnesota. Emphasis is on understanding and using American Indian knowledge systems to describe regional impacts of climate change to Minnesota. Examples may include the water cycle and how precipitation change over time impacts cultural practices related to nibi ("water" in the Ojibwe language), or the decline/species loss of wiigwaas ("paper birch" in the Ojibwe language and an important tree in Anishinaabe culture) due to climate stressors like drought or changes in snow cover.*	