Virginia Expanded High School Science

Grade 9: Environmental Science

The student will demonstrate an understanding of scientific and engineering practices by ENV.1

a asking questions and defining problems ENV.1.A

1. ask questions that arise from careful observation of phenomena and/or organisms, from examining models and theories, and/or to seek additional information ENV.1.A.1
2. determine which questions can be investigated within the scope of the school laboratory or field ENV.1.A.2
3. make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated ENV.1.A.3
4. generate hypotheses based on research and scientific principles ENV.1.A.4
5. define design problems that involve the development of a process or system with multiple components and criteria ENV.1.A.5

b planning and carrying out investigations ENV.1.B

1. plan and conduct observational and experimental investigations; identify variables, constants, and controls where appropriate ENV.1.B.1
2. plan and conduct investigations or test design solutions in a safe and ethical manner including considerations of environmental, social, and personal effects ENV.1.B.2
3. select and use appropriate tools and technology to collect and record data ENV.1.B.3
4. determine appropriate sample size and techniques ENV.1.B.4

c interpreting, analyzing, and evaluating data ENV.1.C

1. construct and interpret data tables showing independent and dependent variables, repeated trials, and means ENV.1.C.1
2. construct, analyze, and interpret graphical displays of data and consider limitations of data analysis ENV.1.C.2
3. use data to build and revise models, to support an explanation for phenomena, or test a solution to problems ENV.1.C.3
4. apply mathematical concepts and processes ENV.1.C.4
5. analyze data using tools, technologies, and/or models to make valid and reliable scientific claims or determine an optimal design solution ENV.1.C.5

d constructing and critiquing conclusions and explanations ENV.1.D

1. construct and revise explanations based on valid and reliable evidence obtained from a variety of sources including models, theories, simulations, peer review, and students' own investigations ENV.1.D.1
2. make quantitative and/or qualitative claims based on data ENV.1.D.2
3. apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and design solutions ENV.1.D.3
4. compare and evaluate competing arguments or design solutions in light of currently accepted explanations and new scientific evidence ENV.1.D.4
5. make and support a claim using empirical evidence and scientific reasoning ENV.1.D.5
6. evaluate a claim by applying scientific reasoning, theory, and/or models to link evidence to assess the extent to which the reasoning and data support the explanation or conclusion. ENV.1.D.6
7. differentiate among a scientific hypothesis, theory, and law ENV.1.D.7

e developing and using models ENV.1.E

1. evaluate the merits and limitations of models ENV.1.E.1
2. develop, revise, and/or use models based on evidence to illustrate or predict relationships, to support explanations, predict phenomena, analyze systems, and/or solve problems ENV.1.E.2

f obtaining, evaluating, and communicating information ENV.1.F

1. compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem ENV.1.F.1
2. gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and credibility of each source ENV.1.F.2
3. communicate scientific and/or technical information about phenomena and/or a design process in multiple formats ENV.1.F.4

The student will investigate and understand that matter and energy move within and among Earth's systems. Demonstration of the essential knowledge and practices includes: ENV.2

a Make, support, and evaluate a claim about how Earth is a system composed of interacting components. ENV.2.A

b Explain the importance of the properties and characteristics of water in supporting life processes and Earth systems. ENV.2.B

c Develop and use a model to explain how biogeochemical processes support life and demonstrate the conservation of matter and energy. ENV.2.C

d Develop and use a model of Earth's energy budget to predict how fluctuations and changes in the budget might affect Earth's ability to sustain life. ENV.2.D

The student will investigate and understand that processes and systems lead to changes on Earth's surface. Demonstration of the essential knowledge and practices includes: ENV.3	**a** Plan and conduct an investigation on the effect of processes on Earth's surface. ENV.3.A
	b Develop and use a model to explain how processes of the rock cycle change Earth's surface. ENV.3.B
	c Make, support, and evaluate a claim about how natural processes and human activities have changed Earth's surface. ENV.3.C
The student will investigate and understand that ecosystems are in a state of dynamic equilibrium that is affected by complex biotic and abiotic interactions. Demonstration of the essential knowledge and practices includes: ENV.4	**a** Compare biotic and abiotic factors in terrestrial and aquatic ecosystems. ENV.4.A
	b Describe the ecological role that an organism plays in supporting the overall sustainability of the ecosystem. ENV.4.B
	c Predict the effect caused by the introduction of a non-native species on the equilibrium of an ecosystem. ENV.4.C
	d Develop and use models to predict the effects of energy and matter transfer in ecosystems. ENV.4.D
	e Make, support, and evaluate a claim about how energy and matter is conserved in ecosystems. ENV.4.E
	f Make, support, and evaluate a claim about how environmental pressures may lead to shifts in ecosystem equilibrium. ENV.4.F
	g Predict the effect of natural processes and human activities on Virginia's biodiversity and ecosystem equilibrium. ENV.4.G
The student will investigate and understand that changes in population affect biodiversity and ecosystem success. Demonstration of the essential knowledge and practices includes: ENV.5	**a** Analyze and interpret population growth curves to identify changes in population size. ENV.5.A
	b Make, support, and evaluate a claim about the relationship among limiting factors, population size, and carrying capacity. ENV.5.B
	c Make, support, and evaluate a claim about the importance of genetic variation (e.g., mutation, gene flow) on the biodiversity of an ecosystem. ENV.5.C
	d Develop and use a model to explain how species diversity is affected by environmental pressures. ENV.5.D
	e Explain how human population growth changed over time as a result of various factors (e.g., pandemics, agricultural revolution, industrial revolution, medical advances) and predict the effect of continued growth on the environment. ENV.5.E
The student will investigate and	**a** Make, support, and evaluate a claim about how sustainable and unsustainable natural resources affect organisms. ENV.6.A

understand that Earth's resources are finite and should be conserved. Demonstration of the essential knowledge and practices includes: ENV.6	**b** Compare geologic and chemical processes that are responsible for filtering, cycling, and storing Earth's freshwater resources. ENV.6.B
	c Debate the advantages and disadvantages of a sustainable practice in a community, in a home, and as an individual. ENV.6.C
	d Compare environmental effects related to the various energy sources in Virginia. ENV.6.D
The student will investigate and understand that pollutants have physical, chemical, and biological consequences at the local, regional, and global level. Demonstration of the essential knowledge and practices includes: ENV.7	**a** Use data to identify a land, water, or atmospheric pollutant in the local community and determine possible sources and effects on the environment. ENV.7.A
	b Debate the advantages and disadvantages of solutions to safely reduce, eliminate, or remediate a land, water, or atmospheric pollutant. ENV.7.B
	c Compare the benefits and limitations of remediation methods used with land, water, atmospheric pollutants. ENV.7.C
	d Analyze and evaluate a clean-up plan for a designated Environmental Protection Agency Superfund site. ENV.7.D
The student will investigate and understand that natural events and human activities affect global climate change. Demonstration of the essential knowledge and practices includes: ENV.8	**a** Make, support, and evaluate a claim about how human activities affect global climate change. ENV.8.A
	b Compare the effects of natural events and human activities on global climate change. ENV.8.B
	c Develop and use a model to explain how changes in global temperature affects a specific ecosystem. ENV.8.C
	d Make, support, and evaluate a claim about how climate change affects Virginia communities. ENV.8.D
	e Research ways to mitigate greenhouse gas emissions and propose solutions to reduce emissions in the school, home, and community. ENV.8.E
The student will investigate and understand that their actions as an environmentally literate individual play a role in environmental policies. Demonstration of the essential knowledge and practices includes: ENV.9	**a** Make, support, and evaluate a claim about how consumer choices can affect the environment. ENV.9.A
	b Compare the priorities of multiple stakeholders involved in an environmental issue that affects global and/or local ecosystem health. ENV.9.B
	c Debate the advantages and disadvantages of possible solutions to an environmental problem. ENV.9.C

d **Research solutions that reduce effects of human activities on natural systems and propose solutions for school, home, and community to reduce these effects.** ENV.9.D