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Appendix A

Table 1. Detailed EK Themes (Year 1 and Year 2) within Vietnamese Natural Science curriculum

Environmental Knowledge Themes		Sub - EK	Indicator	Grade	Content of Natural Science curriculum
EK2	Individuals, Populations, and Levels of Organization in Ecology	A. The "individual" as one organism of a given plant or animal species		6	From Cell to Body Biodiversity
		B. The "population" as a group of organisms of the same species living in a particular habitat (area) at a particular time		8	Ecosystem: the Definition of Population
		C. The "community" as interacting populations of plants and animals living in a given habitat (area) at a particular time			Ecosystem: the Definition of Communities
		D. The "ecosystem" as the community concept but with the added consideration of the nonliving environment (chemical and physical)	1. Life-related variables called "biotic" variables 2. Nonliving variables called "abiotic" variables		Environment and Ecological Factors: Abiotic and Biotic Ecological Factors
			3. How living and nonliving variables influence each other		Ecosystem: Metabolism and Energy Transformation in an Ecosystem
		E. The "biome" as an aggregate of ecosystems with similar vegetative types F. The biome, in reality, as one very huge ecosystem G. Major biomes around the world H. Climate as the key variable in producing biomes I. The "biosphere" as the composite of all earth ecosystems			Biosphere and Biome on the Earth
EK3	The "Ecosystem Concept" Developed	B. Local/regional ecosystems		8	Ecosystems: Types of Ecosystems
		C. Components of ecosystems	1. Biotic variables 2. Abiotic variables		Ecosystem: the Definition of Ecosystem
			3. The critical nature of biogeochemical cycles		Ecosystem: the Cycle of Substances
		F. Tolerance ranges and limiting factors in ecosystems	1. The "law of tolerance"		Environment and Ecological Factors: Abiotic and Biotic Ecological Factors
		G. A summary of the ecosystem concept			Environment and Ecological Factors Ecosystem
EK4	Energy and Ecosystems	A. The need for energy to "drive" ecosystems B. The sun as the source of energy for driving ecosystems		8	Ecosystem: Metabolism and Energy Transformation in an Ecosystem
				9	Energy and Life: Energy Cycle on the Earth
		C. Green plants as the basis for energy production	1. The process of photosynthesis	7	Metabolism and Energy Conversion in Organisms
			2. How photosynthesis in green plants supports consumer organisms	8	Ecosystem: Metabolism and Energy Transformation in an Ecosystem
		D. Energy losses in food chains	1. Energy lost at each step in a food chain: the 10-1 ratio 2. Energy loss vs the number of steps in a food chain 3. The concept of the "energy pyramid"		
EK6	Populations and Their Dynamics	A. Species populations form communities		8	Ecosystem: the Definition of Communities
		B. Characteristics of species populations			Ecosystem: the Definition of Population, Basic Characteristics of the Population
		C. The importance of the group (population) rather than individuals within the group			Ecosystem: the Definition of Population
EK7	Humans As An Ecological Factor	A. Humans as a powerful ecological variable	3. Human potential for environmental preservation/issue resolution	8	Environmental Conservation: Human Impact on the Environment

		G. Humans and the world's wildlife	2. Ecological importance of wildlife		Natural Equilibrium: Wildlife Conservation
			5. Reasons for wildlife losses		Natural Equilibrium: Causes of Natural Imbalance
			6. Protecting wildlife		Natural Equilibrium: Measures for Sustaining Natural Balance
		E. Humans and the world's forests	1. Human cut and burn forests at an alarming rate 4. Possible solutions	6	Biodiversity: Plant Diversity
		I. Humans and Sustainable Development	2. Dimensions of sustainable development		Biodiversity: The Role of Biological Diversity
EK8	Humans Their History of Resource Consumption	A. Early humans: hunters and gatherers B. Agricultural societies C. Industrial Societies	1. The domestication of plants and animals 2. Small-scale farming 3. True agriculture of past societies 4. Agriculture-based urban societies 5. Environmental impact of agriculture based urban societies	8	Environmental Conservation: Human Impact on the Environment
		D. The relationship of population to resource use! pollution? and environmental degradation.	4. Pollution and resource consumption	9	Polymer: Applications of Polyethylene
EK9	Soils and Allied Problems	A. A definition of "soil"	1. Inorganic components of soil	9	Resource Extraction from the Earth's Crust
EK10	Water and Allied Problems	C. Problems with water resources	2. Excess water and allied problems	8	Environmental Conservation: Human Impact on the Environment
EK11	Food Production and Hunger	D. World food problems	2. Nutritional problems	8	Nutrition and Digestion in Humans
		E. The "green revolution"	3. Limitationiis of the "green revolution"	8	Chemical Fertilizers
EK12	Forest Resources	A. Importance of forest resources	1. Commercial importance 2. Ecological importance 3. Climate importance 4. Pollution importance	8	Ecosystem: Concepts, Types of Ecosystems, Ecosystem Protection (including forest ecosystems)
EK13	Plant and Animal Resources	C. Protecting species from extinction		8	Natural Equilibrium: Strategies for Maintaining Natural Balance
EK14	Air Pollution	A. Sources of air pollution	2. Coal and oil burning power plants	9	Energy and Life: Fossil Fuels Resource Extraction from the Earth's Crust: Carbon Source, Carbon Cycle, and Global Warming Hydrocarbons: Fuel Source
				6	Oxygen and Air: Pollution Source Several common materials, fuels, raw materials, and foodstuffs; their properties and applications.
		C. Impact of air pollution on human health	2. Chronic respiratory disease 3. Acute respiratory disease	8	Human Respiratory System: Respiratory Disease
		E. Indoor air pollution	2. Products of combustion		
EK15	Water Pollution	A. Sources of freshwater surface pollution	2. Nonpoint sources	8	Environmental Conservation: Environmental Pollution, Reducing Environmental Pollution
		C. Oceanic pollution	1. Threats to the oceans' ecosystems		
		D. Groundwater pollution	2. Sources of groundwater contamination		
EK16	Noise Pollution	B. Effect of noise on the human organism C. Noise control		7	Sound: Options for Noise Reduction Affecting Health
EK17	Solid Waste Disposal	C. Sources of municipal waste	1. Paper 2. Food 3. Yard waste (leaves, etc.) 4. Glass 5. Metals 6. Wood 7. Plastics 8. Rubber 9. Leather 10. Textiles	8	Environmental Conservation: Environmental Pollution, Reducing Environmental Pollution

	E. Methods of municipal waste disposal	1. Water dumping 2. Open dumping – littering 5. Composting 6. Resources recovery		
EK18 Hazardous Waste	B. Sources of hazardous waste	1. Chemical industries	9	Human Genetics: Genetic Factors Causing Diseases
EK19 Human Population Growth and Control	H. Birth control and population dynamics	1. Preventing pregnancies	8	Reproduction: Protecting the Reproductive System, Protecting Reproductive Health.

Appendix B

Table 2. Detailed EK Themes (Year 3) within Vietnamese Natural Science curriculum

Environmental Knowledge Themes		Sub - EK	Natural Science curriculum
EK20	Environmental Problem Solving	A. Human-environment interactions B. Quality of life vs quality of the environment C. Environmental problems and issues D. Issue analysis - a way to understand the anatomy of issues E. Presenting examples (models) of issues which have been analyzed F. Applying issue analysis skills to discrete issues	- Oxygen and air: Analyze the issue of air pollution and propose measures to protect air quality. - Energy: Analyze and propose measures to save energy in daily activities towards environmental protection and sustainable development. - Sound: Analyze and propose simple solutions to reduce noise pollution that affects health. - Metabolism and energy transformation in organisms: Conduct a project to raise awareness about the practical significance of planting and protecting trees. - Energy and life: Investigate the current energy usage and propose measures to effectively use renewable energy for environmental protection. - Exploiting resources from the Earth's crust: Propose measures to limit the use of fossil fuels and reduce carbon dioxide emissions both locally and globally. - Hydrocarbons: Propose appropriate ways to use fuels (gas, petrol, kerosene, coal, etc.) to protect the environment.
IEK21	Identifying Issues and Preparing Research Questions	A. Identifying environmental issues B. Identifying variables associated with environmental issues C. Formulating (writing) research questions for issue investigation	
EK22	Using Secondary Sources for Obtaining Issue Information	A. Secondary sources of issue-related information B. Processing information from secondary sources C. Reporting secondary source information	- Human impact through different periods of social development: Use descriptions to identify environmental issues resulting from human activities. - Environmental pollution: Use illustrations and photos to recognize types of pollution and their causes, and propose measures at home and school to reduce environmental pollution.
EK23	Using Primary Sources for Obtaining Issue Information	A. Surveys, questionnaires, and opinionnaires (survey instruments) B. The interview as an important research technique C. Selecting the appropriate population to be sampled D. Basic procedures to be used in sampling populations E. Data collection strategies F. Developing and using survey instruments/interviews	- Common materials, Fuels, Raw Materials, and Food: Their properties and applications: + Collect data, analyze, discuss, and compare to draw conclusions about the properties of some common materials, fuels, raw materials, and food. At the same time, assess their environmental impact and contribution to sustainable development. + Propose ways to use certain raw materials, fuels, and materials safely and efficiently, ensuring environmental protection and sustainable development. - Human Respiration: Conduct a project investigating the local status of tobacco smoking; design posters to promote anti-smoking campaigns. - Exploiting Resources from the Earth's Crust: Conduct a project investigating the consequences of climate change and weather due to the effects of global warming in recent times; raise awareness about measures to reduce the negative impacts of climate change.
EK24	Interpreting Data from Environmental Issue Investigations	A. Organizing data in data tables B. Communicating data by graphing C. Interpreting data - skill development sequence D. Applying data interpretation shills to issue-related data sets	
EK25	The Independent Investigation of a Student-Selected Environmental Issue	A. Selecting an issue for investigation B. Formulating research questions to guide the investigation C. Collecting secondary information D. Collecting primary information	- Biodiversity of the Living World: Conduct an investigation into the biodiversity of a local ecosystem. + Select a specific issue related to biodiversity in the local area. + Gather information about local biodiversity through various sources (books, newspapers,

		E. Issue analysis/data interpretation	statistical reports, etc.). + Apply methods of studying living organisms in the natural environment: observe with the naked eye, magnifying glass, binoculars; record, measure, count, make observations, and draw conclusions; take photographs and create a photo collection of different groups of organisms (plants, vertebrates, invertebrates). + Use a dichotomous key to classify some groups of organisms; identify the roles of organisms in nature (e.g., shade trees, climate regulation, environmental purification, food for animals, etc.). + Create and present a report on the findings from studying organisms in the natural environment. - Environmental Protection: Conduct an investigation into local environmental pollution issues.
		F. Communication of investigation and results	
EK26	Issue Resolution: Skills and Application	A. Citizenship responses to issues and their effects	
		B. Principles of environmental (citizenship) action	
		C. The methods (modes) of citizenship action	
		D. Effectiveness of individual vs group action	
		E. Guidelines for decision-making - criteria to be considered:	
		F. Applying issue resolution skills	