

- 1- Environmental Issues – The student will investigate and analyze environmental issues ranging from local to global perspectives and develop and implement a local action project that protects, sustains, or enhances the natural environment.**

#### **Standard 1 Components: Environmental Issue Investigation and Action**

The Environmental Issue component requires students to: Identify an environmental issue; Develop and write research questions related to an environmental issue and, given a specific issue, communicate the issue, the stakeholders involved and the stakeholder's beliefs and values. The student also will design and conduct research, and use the data and references collected to interpret findings to form conclusions and inferences.

In the Action component, the student will develop and implement an environmental action plan. Students will need to communicate, evaluate and justify personal views on a local environmental issue and alternate ways to address it, as well as, analyze the effectiveness of the action plan in terms of achieving the desired outcomes.

- 2- Interactions of Earth's Systems – The student will analyze and apply the properties of systems thinking and modeling to the study of Earth's systems.**

#### **Standard 2 Components: Earth Systems and Systems Thinking.**

Through Earth's Systems, the student will analyze and explain the interactions between the earth's systems: the geosphere, hydrosphere, atmosphere, cryosphere, and biosphere. The students will describe the relationships among the earth's systems and cite evidence to show interactions among the solid earth, oceans, atmosphere and organisms resulting in the on-going evolution of earth's systems.

In Systems Thinking, students will analyze, explain and apply the properties of systems thinking to earth system interactions. Students will define a system, cite examples, observe and demonstrate interactions and differences between systems. Models and computer simulations are required to extend the understanding of scientific concepts.

- 3- Flow of Matter and Energy – The student will analyze and explain the movement of matter and energy through interactions of earth's systems (biosphere, geosphere, hydrosphere, atmosphere and cryosphere) and the influence of this movement on weather patterns, climatic zones, and the distribution of life.**

#### **Standard 3 Components: Conservation of Matter within Earth Systems and Energy Distribution through Earth Systems.**

In Conservation of Matter within Earth Systems, students will demonstrate that matter cycles through and between living systems and the physical environment, constantly being recombined in different ways. Students will demonstrate knowledge that the earth contains

fixed amounts of chemical elements that can exist in the solid earth, oceans, and/or the atmosphere and organisms as part of the biological cycle. They will describe that the movement of matter between reservoirs is driven by the earth's internal and external sources of energy and change the physical and chemical properties of matter.

In Energy Distribution through Earth Systems, students will analyze how the position and movement of the Earth in space determine distribution of heat and light, internal and external sources of Earth's heat, utilizing models of the earth's tilt in seasonal variation and temperature and intensities of sunlight's result on temperature and seasons. Students will explain and diagram how greenhouse gases increase thermal energy in the atmosphere and its effect on earth's temperature and systems. Students should also be able to explain that transfer of thermal energy between the atmosphere and the land or oceans produce temperature and density gradients in the atmosphere and the oceans. As well as being able to demonstrate an understanding that transfers of thermal energy between the atmosphere and the land or oceans influences climate patterns.

- 4- **Populations, Communities and Ecosystems – The student will use physical, chemical, biological, and ecological concepts to analyze and explain the interdependence of humans and organisms in populations, communities and ecosystems.**

**Standard 4 Components: Cycling of Matter and Energy, Population Dynamics, Community and Ecosystem Dynamics, Stability in Populations, Communities and Ecosystems, and Diversity.**

Cycling of Matter and Energy will explain how organisms are linked by the transfer and transformation of matter and energy at the ecosystem level. Students describe how the process of photosynthesis connects the sun and energy of a living system, explain and demonstrate that the earth can be considered a single global food web and use energy and biomass pyramids to explain the cycling of matter. Finally, students will develop a model to demonstrate or illustrate how marine and terrestrial food webs are part of one larger system for cycling matter and transferring energy.

Population Dynamics, allows students to analyze growth or decline of populations and to identify a variety of responsible factors. Students will do this using a model or case study, calculations of the differences in growth curves, discussion of factors that limit population size, carrying capacity, and explain how technologies affect human population dynamics. Students will research and explain past century agricultural technology, the size, rate, and of growth of human populations and finally, investigate and communicate findings effectively.

Community and Ecosystem Dynamics: Students will explain how the interrelationships and interdependencies of organisms and populations contribute to the dynamics of communities and ecosystems. Students will use a model, primary research or case studies to illustrate the finite

amount of matter available to living things and that living things compete for matter and energy. Students should be able to describe and cite examples of interactions and interdependence of organisms in ecosystems as both cooperative and competitive. Through the use of models or case studies students will be able to demonstrate that the competition between species may lead to the elimination of one or to the partitioning of resources.

In Stability in Populations, Communities and Ecosystems, students will use models and provide examples to show how the interaction and interdependence of populations contribute to the stability of populations, communities and ecosystems. In addition, models and examples will be used to show how species' interactions may generate ecosystems that are stable for hundreds or thousands of years.

In Diversity, students will provide examples and evidence to show that a greater diversity of genes, species and/or environments increases the chance that at least some living things will survive in the face of large changes in the environment.

**5- Humans and Natural Resources – The student will use concepts from chemistry, physics, biology, and ecology to analyze and interpret both positive and negative impacts of human activities on earth's natural systems and resources.**

**Standard 5 Components: Human Impact on Natural Processes, and the Human Impact on Natural Resources.**

In The Human Impact on Natural Processes, students will analyze the effects of human activities on earth's natural processes and will be able to: Explain that human population's interact with the earth; Identify and describe the basic processes which affect humans as a result of the natural ecosystems; Explain how and why humans modify ecosystems; Cite examples and descriptions of how natural systems are able to reduce waste; Describe how materials from human societies affect the physical and chemical cycles of earth; Investigate, analyze and explain human impacts on global stability; Understand the use of ecological forecasts to predict impacts of damages to ecosystems, ecosystem components and people.

When investigating The Human Impacts on Natural Resources, students will analyze, from local to global levels, the relationship between human activities and the earth's resources. Evaluations should be conducted to show the interrelationships between humans and water, the ocean, the land, air quality, and energy resources. In addition, students will be able to recognize and explain that activities and technology of the human species have a major impact on other species in various ways and they will be able to analyze ways that humans are changing ecosystem processes and the potential impact on species.

**6- Environment and Health – The student will use concepts from science, social studies and health to analyze and interpret both positive and negative impacts of natural events and human activities on human health.**

**Standard 6 Components: Natural Changes and Human Health, Human Induced Changes and Human Health, and Hazards and Risk Analysis.**

Natural Changes and Human Health: The student will identify and describe natural changes in the environment that may affect the health of human populations and individuals. They will be able to describe and explain internal and external processes of the earth, identify natural hazards, coastal hazards specific to Maryland and cite examples of: normal adjustments to the earth, natural hazards that are rapid (earthquakes, volcanic eruptions) and slow and progressive (coastal erosion, sedimentation.) Students should cite examples and evidence that shows how natural systems can change to an extent that exceeds the limits of the organisms to adapt naturally or for humans to adapt technologically.

Human-Induced Changes and Human Health encourage students to describe and explain that many changes in the environment designed by humans as benefits to society also cause risks. Students should identify the risks and benefits associated with natural events, chemical elements and compounds, biological factors, social factors and personal behaviors. They should then analyze evidence of a variety of factors both positive and negatively influencing the length and quality of human life and be able to explain how maintaining environmental health involves establishing or monitoring quality standards related to the use of soil, water and air.

Hazards and Risk Analysis emphasizes an analysis and explanation of how human activities, products, processes, technologies, and inventions can involve some level of risk to human health. Students will be able to understand that natural and human-induced hazards present the need for humans to assess potential danger and risk. To recognize and demonstrate, students will use a systematic approach to think critically about risks and benefits by applying probability estimates and comparison of personal and social benefits. Students should also be able to recognize and explain how risk analysis considers hazards and estimates the number of potentially affected people. Data and example comparisons should be used to understand costs and tradeoffs of hazards and of important personal and social decisions that are made or were previously made based on the perceptions of benefits and risks.

**7- Environment and Society – The student will analyze how the interactions of heredity, experience, learning and culture influence decisions and social change.**

**Standard 7 Components: Environmental Quality, Individual and Group Actions and the Environment, Cultural Perspectives and the Environment, Political Systems and the Environment, Economics and Environment, and Technology and Environment.**

In Environmental Quality, students will examine factors which influence environmental quality by using primary and secondary data sources to investigate influences such as population growth, age, gender, race, ethnicity, poverty, etc.

Individual and Group Actions and the Environment: Students examine the influences of individual and group actions on the environment and explain how groups and individuals can work to promote and balance interests. Students will also examine influences such as government policies, energy use, waste disposal, natural resource and ecological education, citizen wide action, decision making guidelines and understanding of modes of action.

In Cultural Perspectives and the Environment, students will investigate cultural perspectives and dynamics and be able to explain that differences in the behavior of individuals arise from the interaction of culture and experiences.

Political Systems and the Environment provide students an understanding of different political systems, what they account for, manage, and how they affect natural resources and environmental quality. Students should be able to define public policy and allocating resources, identify the private sector, government, and public sector as parts of society involved in public policy making. In addition, they should evaluate, take and defend positions and explain the role of public policy when dealing with environmental problems in society, with environmental justice in society, and government policies and practices related to energy use.

In Economics and Environment students will analyze and explain global economics and environmental connections. They should be able to explain differences in climate, uneven distribution of natural resources, analyze examples to illustrate international trade and its complications by political motivation, illustrate the importance of responsible use of resources and how this changes over time and finally, investigate how industrialization brings an increased demand for and use of energy: Contributing to more goods and services as well as depletion of the earth's energy resources and environmental risks.

With Technology and Environment, students will investigate and examine the social and environmental impacts of various technologies and technological systems on the environment, including how technologies affect food production, sanitation, disease prevention, and agricultural technologies. Also, students will investigate a decision involving the implementation of a new technology and present an assessment of risks, costs and benefits, identification of those who suffer, those who pay those who gain, what the risks are and who bears them.

**8- Sustainability – The student will make decisions that demonstrate understanding of natural communities and the ecological, economic, political and social systems of human communities, and examine how their personal and collective actions affect the sustainability of these interrelated systems.**

**Standard 8 Components: Intergenerational Responsibility, Interconnectedness of Systems, Influence of Economic Systems of Sustainability, Influence of Social and Cultural Systems of Sustainability, Limits of Ecological Systems, and an Action Component.**

Intergenerational responsibility provides students an understanding and application of the basic concept of sustainability to natural and human communities. Students will gather this by: defining and explaining the basic concepts of sustainability; list and analyze changing roles and responsibilities; identify natural and agricultural resources where they live; and distinguish natural resources from man-made source. Students should examine resources that: regenerate within a human lifetime; finite resources; identify local plant and animal species Students should identify the social, economic, and political mechanisms that impinge upon use of the resources.

Through Interconnectedness of Systems, students will recognize the concepts of sustainability as a dynamic condition characterized by the interdependency among ecological, economic, and social systems in their community. Students should identify and describe these, explain how natural and build communities are part of a larger system and the interrelationships that exist among those systems. They should describe and explain how sustainable resource use today can lead to basic human needs being met by future generations, identify and describe an unsuitable system and use sustainable principals to redesign it, investigate designs and systems and nature which can serve as models for man-made sustainable products, services, and systems. Finally, students should propose a design for the continuous cycling of biological and technical nutrients for a cradle-to-cradle designed product or system.

Influence of Economic Systems on Sustainability uses investigations to make decisions that demonstrate students understanding of how the dynamics of economic systems affect the sustainability of ecological and social systems. Students should use the United Nations Millennium Development Goals to investigate: causes and potential solutions to poverty; services an ecosystem provides to humans; pros and cons of globalization; true (or full) cost accounting, etc.

Influence of Social and Cultural Systems on Sustainability students will investigate demonstrate understanding of how the dynamics of social and cultural systems affect the sustainability of ecological and economic systems. Students will compare, analyze and discuss the 1948 United Nations Universal Declaration of Human rights and compare this document to the United States Bill of Rights. Research and compare the goals, programs and/or outcome documents or action plans that resulted from the three United Nations International Summit Processes.

Under Limits of Ecological Systems, students will investigate and make decisions that demonstrate understanding of how the dynamics of ecological systems affect the sustainability of social, cultural systems and economic systems. They will collect data to investigate and analyze

how personal consumption patterns affect the sustainability of natural and human communities. Trace the production of an item to determine the true ecological cost of production. Design a product or service to address a problem or issue. Identify local and global “commons” and explain the *Tragedy of the Commons*. Identify a local environmental justice issue and propose possible solutions. Develop a sustainable land-use plan for an under-developed community property or place that provides for a healthy environment, economy and society. Identify the natural capital of a local or global resource and create a graph depicting their relative worth.

Finally in the Action Component, students will identify and implement a personal sustainability action plan. Identify actions that can be taken as individuals and those that require the involvement of other people, organizations or government.