

NAAEE Standards

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Grade 4

Strand 1 Questioning, Analysis, and Interpretation Skills

- A) Questioning**—Learners are able to develop questions that help them learn about the environment and do simple investigations.
- B) Designing Investigations**—Learners are able to design simple investigations.
- C) Collecting information**—Learners are able to locate and collect information about the environment and environmental topics.
- D) Evaluating accuracy and reliability**—Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.
- E) Organizing information**—Learners will be able to summarize observations and describe data, construct, read, and interpret maps, graphs, tables, diagrams, and other displays of data.
- F) Working with models and simulations**—Learners understand that relationships, patterns, and processes can be represented by models.
- G) Drawing conclusions and developing explanations**—Learners can develop simple explanations that address their questions about the environment.

Strand 2 Knowledge of environmental processes and systems

Strand 2.1 The earth as a physical system

- A) Processes that shape the Earth**—Learners are able to identify changes and differences in the physical environment.
- B) Changes in matter**—Learners are able to identify basic characteristics of and changes in matter.
- C) Energy**—While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.

Strand 2.2 The living environment

- A) Organisms, populations, and communities**—Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.
- B) Heredity and evolution**—Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited.
- C) Systems and connections**—Learners understand basic ways in which organisms are related to their environments and to other organisms.
- D) Flow of matter and energy**—Learners know that living things need some source of energy to live and grow.

Strand 2.3 Humans and their Societies

- A) Individuals and groups**—Learners understand that people act as individuals and as group members and that groups can influence individual actions.
- B) Culture**—Learners understand that experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of references.
- C) Political and economic systems**—Learners understand that government and economic systems exist because people living together in groups need ways to do things such as provide for needs and wants, maintain order, and manage conflict.

- D) Global connections**—Learners understand how people are connected at many levels—including the global level—by actions and common responsibilities that concern the environment.
- E) Change and conflict**—Learners recognize that change is a normal part of individual and societal life. They understand that conflict is rooted in different points of view.

Strand 2.4 Environment and society

- A) Human/environment interactions**—Learners understand that people depend on, change, and are affected by the environment.
- B) Places**—Learners understand that places differ in their physical and human characteristics.
- C) Resources**—Learners understand the basic concepts of resource and resource distribution.
- D) Technology**—Learners understand that technology is an integral part of human existence and culture.
- E) Environmental issues**—Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

Strand 3 Skills for understanding and addressing environmental issues

Strand 3.1 Skills for Analyzing and investigation environmental issues

- A) Identifying and investigation issues**—Learners are able to identify and investigate issues in their local environments and communities.
- B) Sorting out the consequences of issues**—As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.
- C) Identifying and evaluating alternative solutions and courses of action**—Learners understand there are many approaches to resolving issues.
- D) Working with flexibility, creativity, and openness**—Learners understand the importance of sharing ideas and hearing other points of view.

Strand 3.2 Decision Making and Citizenship Skills

- A) Forming and evaluating personal views**—Learners are able to identify, justify and clarify their views on environmental issues and alternative ways to address them.
- B) Evaluating the need for citizen action**—Learners are able to think critically about whether they believe action is needed in particular situations and whether they believe they should be involved.
- C) Planning and taking action**—By participating in issues of their choosing—mostly close to home—they learn the basics of individual and collective action.
- D) Evaluating the results of action**—Learners understand that civic actions have consequences.

Strand 4 Personal and civic responsibility

- A) Understanding societal values and principles**—Learners can identify fundamental principles of U.S. society and explain their importance in the context of environmental issues.
- B) Recognizing citizens' rights and responsibilities**—Learners understand the basic rights and responsibilities of citizenship.
- C) Recognizing efficacy**—Learners possess a realistic self-confidence in their effectiveness as citizens.
- D) Accepting personal responsibility**—Learners understand that they have responsibility for the effects of their actions.

Strand 1 Questioning, Analysis, and Interpretation Skills

- A) Questioning**—Learners are able to develop questions that help them learn about the environment and do simple investigations.
- B) Designing Investigations**—Learners are able to design simple investigations.
- C) Collecting information**—Learners are able to locate and collect information about the environment and environmental topics.
- D) Evaluating accuracy and reliability**—Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.
- E) Organizing information**—Learners will be able to summarize observations and describe data, construct, read, and interpret maps, graphs, tables, diagrams, and other displays of data.
- F) Working with models and simulations**—Learners understand that relationships, patterns, and processes can be represented by models.
- G) Drawing conclusions and developing explanations**—Learners can develop simple explanations that address their questions about the environment.

Strand 2 Knowledge of environmental processes and systems

Strand 2.1 The earth as a physical system

- A) Processes that shape the Earth**—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
- B) Changes in matter**—Learners understand the properties of the substances that make up objects or materials found in the environment.
- C) Energy**—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.

Strand 2.2 The living environment

- A) Organisms, populations, and communities**—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.
- B) Heredity and evolution**—Learners have a basic understanding of the importance of genetic heritage.
- C) Systems and connections**—Learners understand major kinds of interactions among organisms or populations of organisms.
- D) Flow of matter and energy**—Learners understand how energy and matter flow among the abiotic and biotic components of the environment.

Strand 2.3 Humans and their Societies

- A) Individuals and groups**—Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation.
- B) Culture**—As they become familiar with a wider range of cultures and subcultures, learners gain an understanding of cultural perspectives on the environment and how the environment may, in turn, influence culture.
- C) Political and economic systems**—Learners become more familiar with political and economic systems and how these systems take the environment into consideration.
- D) Global connections**—Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.
- E) Change and conflict**—Learners understand that human social systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment.

Strand 2.4 Environment and society

- A) Human/environment interactions**—Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.
- B) Places**—Learners begin to explore the meaning of places both close to home and around the world.
- C) Resources**—Learners understand that uneven distribution of resources influences their use and perceived value.
- D) Technology**—Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.
- E) Environmental issues**—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world experience environmental issues similar to the ones they are concerned about locally.

Strand 3 Skills for understanding and addressing environmental issues

Strand 3.1 Skills for Analyzing and investigation environmental issues

- A) Identifying and investigation issues**—Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.
- B) Sorting out the consequences of issues**—Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.
- C) Identifying and evaluating alternative solutions and courses of action**—Learners are able to identify and develop action strategies for addressing particular issues.
- D) Working with flexibility, creativity, and openness**—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.

Strand 3.2 Decision Making and Citizenship Skills

- A) Forming and evaluating personal views**—Learners are able to identify, justify and clarify their views on environmental issues and alternative ways to address them.
- B) Evaluating the need for citizen action**—Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.
- C) Planning and taking action**—As learners begin to see themselves as citizens taking active roles in their communities, they are able to plan for and engage in citizen action at levels appropriate to their maturity and preparation.
- D) Evaluating the results of action**—Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.

Strand 4 Personal and civic responsibility

- A) Understanding societal values and principles**—Learners understand that societal values can be both a unifying and a divisive force.
- B) Recognizing citizens' rights and responsibilities**—Learners understand the basic rights and responsibilities of citizenship and their importance in promoting the resolution of environmental issues.
- C) Recognizing efficacy**—Learners possess a realistic self-confidence in their effectiveness as citizens.
- D) Accepting personal responsibility**—Learners understand that their actions can have broad consequences and that they are responsible for those consequences.

Glossary

- acetaminophen:** a crystalline substance, $C_8H_9NO_2$, used as a headache and pain reliever and to reduce fever ¹
- acid mine drainage:** run-off water from a mine, generally with a pH between 2.0 and 4.5, produced by the oxidation of sulfide minerals within mine rock or tailings piles ³⁴
- acid rain:** natural rainfall which contains nitric and sulfuric acids due to oxides of nitrogen and sulfur dioxide discharged into the air by industries, power plants, and automobiles ²
- advocacy:** the act or process of advocating or supporting a cause or proposal ³
- adaptation:** changes in an organism's physiological structure or function or habits that allow it to survive in new surroundings ⁴
- agricultural BMP:** defined procedures that may be implemented by an agricultural producer in order to operate in a more environmentally responsible manner; agricultural BMPs involve planting and/or harvesting methods, use of cover crops or installation of animal waste storage or rotational grazing facilities, etc. ⁵
- agriculture:** the science, art, or practice of cultivating the soil, producing crops, and raising livestock ³
- algae bloom:** high concentrations of phytoplankton (algae) that occur when conditions, such as light and nutrients, are sufficient to support rapid growth ⁶
- alternate:** leaves not opposite to each other but at regular intervals along a stem ⁶
- amorphous:** lacking definite form; having no specific shape; formless ¹
- amphibian:** a cold-blooded vertebrate that spends some time on land but must breed and develop into an adult in water; frogs, salamanders, and toads are amphibians ²
- amphipod:** any of numerous small, flat-bodied crustaceans of the group Amphipoda, including the beach fleas, sand hoppers, etc. ¹
- anadromous fish:** fish that spend most of their life in salt water but migrate into freshwater tributaries to spawn (e.g., shad, sturgeon) ²
- anoxia:** a condition where no oxygen is present ⁶
- aquatic:** living in water ²
- aquifer:** a water-bearing layer of soil, sand, gravel, or rock that will yield usable quantities of water to a well ⁷
- arborist:** a specialist in cultivating trees, in diagnosing tree diseases, performing tree surgery and maintaining trees ⁸
- auxin:** a plant hormone promoting or regulating growth ⁹
- bacteria:** organisms not able to be seen except under a microscope, found in rotting matter, in air, in soil and in living bodies, some being the germs of disease ¹
- bark:** The dry, dead outer covering of woody branches, stems and roots of plants that is very distinct and separable from the wood itself; it includes all tissue outside the true cambium (growth layer between bark and wood) ⁸
- benthic:** organisms living in or on bottom sediments in aquatic habitats ⁶
- Best Management Practice (BMP):** practice or combination of practices that provide the most effective and practicable means of controlling point and non-point pollutants at levels compatible with environmental quality goals ²
- biodiversity:** The number and variety of organisms found within a specified geographic region ¹
- biomass:** organic, non-fossil material that is available on a renewable basis; includes all biological organisms, dead or alive, and their metabolic byproducts, that have not been transformed by geological processes into substances such as coal or petroleum ³⁴
- blade:** A plant's leaf, such as a blade of grass ⁸
- blue green algae:** a widely distributed group of predominantly photosynthetic prokaryotic organisms; some species can fix atmospheric nitrogen ¹
- botanist:** a biologist specializing in the study of plants ¹
- botany:** the science of plants, their classification, and study ⁸
- brackish:** somewhat salty water, as in an [estuary](#) ²
- branch:** a natural subdivision of a plant stem; especially a secondary shoot or stem ³
- branch node:** the point on a stem where a leaf is attached or has been attached; a joint ¹
- browse:** twigs, leaves, and young shoots of trees and shrubs on which animals feed ¹⁰
- bud:** unexpanded blossoms ⁸
- buffer:** something that serves as a protective barrier ³ (see also "riparian forest buffer")
- buffer strip:** a protective area adjacent to an area requiring special attention or protection ³⁶
- caddisfly:** any of numerous aquatic insects constituting the order Trichoptera, having two pairs of membranous, often hairy wings and superficially resembling moths ¹
- cambium:** the region of tree stems and roots between the sapwood and periderm (bark) which is responsible for secondary growth (diameter growth) of the tree ¹⁰
- canopy:** the top part of a forest; this top layer provides protection for birds and butterflies and shade to cool the forest in summer ²

carbohydrate: any of various neutral compounds of carbon, hydrogen, and oxygen (as sugars, starches, and celluloses), most of which are formed by green plants and which constitute a major class of animal foods ³⁷

catkins: a compound bloom consisting of scaly bracts and flowers usually of one sex ¹¹

cellulose: a stringy, fibrous substance that forms the main material in the cell walls of plants; it is an organic molecule, composed of carbon, hydrogen, and oxygen ¹

chlorophyll: a pigment contained in plants that is used to turn light energy into food; also gives plants their green color ²

circulation: an act or instance of circulating, moving in a circle or circuit, or flowing ¹

composition: a product of mixing or combining various elements or ingredients ³⁷

compost: a mixture of various decaying organic substances, as dead leaves or manure, used for fertilizing soil ¹

compound leaves: a plant with several leaves or leaflets coming from a common leaf stalk is said to have a compound leaf structure ⁶

concentration: the amount of a component in a given area or volume ³

cone: a unisexual reproductive structure of gymnospermous plants such as conifers and cycads, typically consisting of a central axis around which there are scaly, overlapping, spirally arranged sporophylls that develop pollen-bearing sacs or naked ovules or seeds ³²

conifers: any of a group of needle and cone-bearing evergreen trees ¹⁰

conserve: to use or manage (natural resources) wisely; preserve; save ¹

conservation tillage: a strategy that makes the soil more fertile and includes strategic crop rotations, incorporation of organic litter in the soil, and minimizing the tillage (or cultivation) of the fields ¹²

contaminant: an impurity in the environment that may be toxic to sensitive organisms ¹³

contour strip farming: growing crops in strips that follow the contour; strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow ⁹

copepod: any of numerous minute marine and freshwater crustaceans of the subclass Copepoda, having an elongated body and a forked tail ¹

copper: a malleable, ductile, metallic element having a characteristic reddish-brown color: used in large quantities as an electrical conductor and in the manufacture of alloys, as brass and bronze ¹

Coriolis Force: an apparent force that as a result of the earth's rotation deflects moving objects (as projectiles or air currents) to the right in the northern hemisphere and to the left in the southern hemisphere ³

cover crop: a crop of nitrogen fixing plants that is planted with, or in rotation with, edible crops to increase nitrogen, stabilize soil, attract beneficial insects, or to be used as green manure ⁸

crayfish: large, edible marine crustacean having a spiny carapace but lacking the large pincers of true lobsters ¹

crop rotation: the successive planting of different crops on the same land to improve soil fertility and help control insects and diseases ¹

crustacean: any chiefly aquatic arthropod of the class Crustacea, typically having the body covered with a hard shell or crust, including the lobsters, shrimps, crabs, barnacles, and wood lice ¹

dead zones: oxygen-depleted areas where aquatic animals and plants suffocate and die

deciduous: refers to trees which drop their leaves in autumn ¹¹

decompose: to become broken down into components; disintegrate ¹

dendrology: the study, nomenclature, and identification of trees ¹¹

denitrification: the conversion of nitrite and nitrate nitrogen (after nitrification) to inert nitrogen gas; the resultant nitrogen gas is released to the atmosphere ²

detritus: accumulated organic debris from dead organisms, often an important source of nutrients in a food web ²

developed land: a combination of land cover/use categories such as large urban and built-up areas, small built-up areas, and rural transportation land ⁹

diatoms: microscopic algae with plate like structures composed of silica; considered a good food source for zooplankton ²

dichotomous key: a key for the identification of organisms based on a series of choices between alternative characters ³

dissipate: to break up and scatter or vanish ³

dissolved oxygen: amount of oxygen dissolved in water ¹³

diversity: an ecological measure of the variety of organisms present in a habitat ²

dredging: to clear out with a dredge; remove sand, silt, mud, etc., from the bottom of ¹

ecologist: a biologist who studies the relation between organisms and their environment ¹

ecosystem: all the organisms in a particular region and the environment in which they live; the elements of an ecosystem interact with each other in some way, and so depend on each other either directly or indirectly ²

ecosystem function: the interactions between organisms and the physical environment, such as nutrient cycling, soil development, water budgeting, and flammability ³⁸

ecosystem service: a benefit or service provided free by an ecosystem or by the environment, such as clean water, flood mitigation, or groundwater recharge ¹³

edge effect: the effect of an abrupt transition between two quite different adjoining ecological communities on the numbers and kinds of organisms in the marginal habitat ³

elevation: the altitude of a place above sea level or ground level ¹

emissions: refers to pollution being released or discharged into the air from natural or man-made sources; pollutants may be released directly into the air from a structural device (e.g., smokestack, chimney, exhaust pipe) or indirectly via volatilization or dispersal (e.g., aerosol spraying) ²

entire: without teeth or divisions (refers to leaf margins) ⁶

environmental impact: the indirect and direct consequences of human actions on the natural environment ³⁹

erode: to wear (something) away by or as if by abrasion ³²

erosion: the disruption and movement of soil particles by wind, water, or ice, either occurring naturally or as a result of land use ²

erosion control: practices used during construction or other land disturbing activities to reduce or prevent soil erosion ⁴

estrogen: a general term for female steroid sex hormones that are secreted by the ovary and responsible for typical female sexual characteristics ¹

estuarine: pertaining to an estuary, an area open or adjacent to the sea, typically at the mouth of a river, subject to tidal movement ⁶

estuary: a semi-enclosed body of water that has a free connection with the open sea and within which seawater (from the ocean) is diluted measurably with freshwater that is derived from land drainage (e.g., the Chesapeake Bay) ²

evergreen: a plant that retains green leaves throughout the year; life span of an individual leaf can be two to 15 years ¹¹

family: a taxonomic category of related organisms ranking below an order and above a genus; a family usually consists of several genera ¹

fecal coliform: microscopic single-celled organisms found in the wastes of warm-blooded animals (including humans and birds); their presence indicates the possible presence of pathogenic (disease producing) organisms ¹⁴

fertilizer: any of a large number of natural and synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into soil to increase its capacity to support plant growth ¹

fire suppression: stopping or slowing fire spread to contain and extinguish all fire ¹⁵

fish kill: mass death of many fish, usually in a restricted area ²³

fishery: the occupation or industry of catching, processing, or selling fish or shellfish; a place where fish or shellfish are caught; a place where fish are bred; fish hatchery ¹

fish ladder: a series of pools arranged like steps by which fish can pass over a dam in going upstream ³

fishway: see “fish ladder”

flood control dam: a man-made barrier built to retain water so that it does not flood an area

flower: the part of a seed plant that normally bears reproductive organs ³

food chain/web: the network of feeding relationships in a community as a series of links of trophic levels, such as primary producers, herbivores, and primary carnivores; includes all interactions of predator and prey, along with the exchange of nutrients into and out of the soil; these interactions connect the various members of an ecosystem, and describe how energy passes from one organism to another ²

forester: an officer having responsibility for the maintenance of a forest ¹

forestry: the science, art, and practice of managing and using trees, forests, and their associated resources for human benefit ⁴⁰

fragmentation: the break up of an organism’s population and breeding grounds; the reduction in connectivity among ecosystems within a landscape ⁴¹

fruit: the seed-bearing structure in angiosperms formed from the ovary after flowering ³⁸

fry: recently hatched fish ¹⁰

genetic: of or having to do with the precise heritable traits (genes) retained by an individual ⁴¹

genus: the usual major subdivision of a family or subfamily in the classification of organisms, usually consisting of more than one species ¹

geologic: referring to the history and structure of the solid portion (rocks, soils, and minerals) of the earth ⁴

geological: of or relating to or based on geology; geological formations; geologic forces ⁴²

geomorphic activity: changes in the folds, faults, structural shapes, and effects of the earth’s surface and the processes that create them ²

germination: to cause to sprout or develop ³

gestation: the period of fetal development from conception until birth; pregnancy ¹

green roof: combination of vegetation planted on a roof top that helps filter pollutants, reduce runoff, and reduce energy demands for heating and cooling the building ¹⁶

groundwater: the water beneath the surface of the ground, consisting largely of surface water that has seeped down; the source of water in springs and wells ¹

headwaters: refers to upstream reaches of a stream or river ¹¹

heartwood: inner cylinder of a tree stem consisting of dead xylem tissue; the heartwood usually appears darker than the sapwood ¹⁰

horticulturist: an expert in the science of cultivating plants (fruit or flowers or vegetables or ornamental plants) ¹

hydrologic: the cyclic phenomena of waters of the earth—precipitation, runoff, storage and evaporation ²

hypoxia: a condition where only very low levels of oxygen are present ⁶

impervious: surfaces that will not allow things to pass through; paved roads, sidewalks and driveways are examples ²

indigenous species: a species which evolved on the North American continent, was present at the time of European Colonization, and is resident within the Chesapeake Bay basin without human manipulation ²

industrial: land use that is primarily for businesses such as warehouses, manufacturing plants, automobile service shops, etc. ⁶

industrial pollution: pollution resulting from an industrial plant discharging pollutants into the air ¹⁷

infiltration trenches: long, narrow, shallow excavations located over porous soils and back-filled with stone to form a subsurface reservoir to hold stormwater and allow it to infiltrate the soil; infiltration trenches remove fine sediment and the pollutants associated with them ¹⁸

intersex: an individual displaying sexual characteristics of both male and female ¹

intrinsic: belonging to the essential nature or constitution of a thing ³

invasive plant: any [plant] species, including its seeds, spores, or other biological material capable of propagating that species, that is not native to that ecosystem, and whose introduction does or is likely to cause environmental harm ⁴³

invasive species: an alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health ¹³

lamina: a thin plate or scale; specifically, the blade or expanded part of a leaf or petal ⁸

lateral bud: a bud that develops in the axil between a petiole and a stem ³

leach field: porous soil area, through which septic tank leach lines run, emptying the treated waste ⁴⁴

leaching: to remove (nutritive or harmful elements) from soil by percolation ³

leaf: lateral outgrowth from a plant stem that is typically a flattened, expanded, variably shaped, greenish organ; constitutes a unit of the foliage, and functions primarily in food manufacture by photosynthesis ³

leaflet: a leaf-like portion of the blade of a compound leaf; there is no bud in the axil of its petiole ¹¹

leafscar: the impression in a twig at the point where a leaf was attached ¹¹

leaf stalk: the stalk that attaches a leaf to the stem or branch ⁸

legislation: a law or set of laws that is being created ¹⁹

lenticle: a pore in the bark of young trunks and branches through which air passes to interior cells ¹¹

litigation: a legal proceeding in a court; a judicial contest to determine and enforce legal rights ⁴²

loam: soil composed of a mixture of particle sizes, specifically: 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand ²⁰

lobe: a division or projecting part of the blade of a leaf ¹¹

macroinvertebrates: organisms generally associated with soil or stream substrates that lack backbones and can be seen without magnification ¹¹

managerial BMPs: a managerial BMP consists of changes in operational procedures; examples may be changing how the land is used and how stormwater is managed ²¹

margin: the border of a leaf ¹

mayfly: slender insect with delicate membranous wings having an aquatic larval stage and terrestrial adult stage usually lasting less than two days ¹

microbiotic: pertaining to the microbiota, or to microscopic living organisms ²²

midrib: central vein or rib of a leaf ⁸

migrate: to change location periodically, especially by moving seasonally from one region to another ²³

molecule: the smallest particle of a substance that retains all the properties of the substance and is composed of one or more atoms ³⁷

native: originating, growing, or produced in a certain place or region; indigenous ¹

natural boundaries: boundaries created by geologic forces, such as mountains or rivers

natural resources: material source of wealth, such as timber, fresh water, or a mineral deposit, that occurs in a natural state; natural resources are considered nonrenewable when they do not naturally replenish themselves within the limits of human time or renewable when they are more or less continuously replenished in the course of natural events within the limits of human time ¹¹

nitrogen: a nonmetallic element that is necessary for the growth of organisms (especially plants); a constituent of all living tissues; this nutrient at excess quantities in water can promote rampant algal blooms in waterways and ponds, threatening other aquatic life ¹⁴

nitrogen fixation: the assimilation of atmospheric nitrogen by soil bacteria and its release for plant use on the death of the bacteria ¹

non-point source pollutant: pollutant that comes from a variety of sources

no-till farming: planting crops without prior seedbed preparation, into an existing cover crop, sod, or crop residues, and eliminating subsequent tillage operations ²⁴

nutrient pollution: contamination of water resources by excessive inputs of nutrients; in surface waters, excess algal production is a major concern ²⁴

nutrients: a source of nourishment, especially a nourishing ingredient in a food ¹

opposite: leaves arranged directly across from one another along a stem ⁶

organic compounds: chemical compounds containing the element carbon; these compounds are the primary constituents of living matter ⁶

organism: an individual form of life, such as a plant, animal, bacterium, protist, or fungus; a body made up of organs, organelles, or other parts that work together to carry on the various processes of life ¹

ornamental: a plant cultivated for its beauty rather than for use ³

overharvesting: collecting too many of a plant or animal species for educational or scientific purposes that may affect the species' overall survival ¹³

palmate: having four or more lobes, leaflets, or nerves radiating from a single point; the leaves are arranged as a hand with outstretched fingers ⁸

percolation: the slow passage of a liquid through a filtering medium ¹

parasite: an organism that lives off or in another organism, obtaining nourishment and protection while offering no benefit in return ¹

particulate: a very small particle, as of dust or soot; particulates that are given off by the burning of oil, gasoline, and other fuels can remain suspended in the atmosphere for long periods, where they are a major component of air pollution and smog ¹

PCBs: short for polychlorinated biphenyl; any of a family of very stable industrial compounds used as lubricants, heat-transfer fluids, and plasticizers; the manufacture and use of PCBs has been restricted since the 1970s because they are very harmful to the environment, being especially deadly to fish and invertebrates, and stay in the food chain for many years ¹

persistent: continuing or permanent ¹

petiole: the stalk attaching a leaf blade to the stem ¹¹

phloem: active, conductive tissue of the inner bark of trees or other ¹⁰

phosphorous: a chemical element essential for growth, however, in excess it can cause an overabundance of bacteria and algae in waterways (algal bloom) that threatens other aquatic life ¹⁴

photosynthesis: the process by which plants convert carbon dioxide and water into carbohydrates and oxygen; the carbohydrates are then available for use as energy by the plant or other consuming organisms; ($\text{CO}_2 + \text{H}_2\text{O} + \text{SUNLIGHT} = \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$); this process is also referred to as "primary production" ²

physiography: the description of surface features of the earth such as bodies of air, water, and land ¹³

phytoplankton: plankton are usually very small organisms that cannot move independently of water currents; phytoplankton are any plankton that are capable of making food via photosynthesis ²

pinnate: compound leaves arranged on both sides of a common axis, as in a feather ⁶

plateau: a usually extensive land area having a relatively level surface raised sharply above adjacent land on at least one side ³⁷

pod: a dry fruit or seed vessel that bursts open when mature and is more or less elongated and cylindrical or flattened, as of the pea, bean, or catalpa ⁸

point source pollutant: pollutant that originates from a single source ¹¹

political boundaries: boundaries created by people and governments, such as states and countries

pollutant: Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems ⁴

pollution: the introduction of harmful substances or products into the environment ¹

polymer: large organic molecule formed by combining many smaller molecules (monomers) in a regular pattern ⁴⁵

porous pavement: surface that allows water to be absorbed into the ground ¹⁶

precipice: a very steep or overhanging place ³⁷

precipitation: rain, snow, and other forms of water that fall to earth ⁹

prey: an animal hunted or seized for food ¹

propagation: increase (as of a kind of organism) in numbers ³

prune: to cut back parts of plants for better shape, disease control, or improved fruiting ⁴⁶

pupae: the stage between larval and adult where insects undergo extensive body transformations during dormancy or inactivity ⁴¹

pycnocline: the depth in a water column where there is an abrupt change in density, temperature, and salinity; a pycnocline often forms in the Chesapeake Bay and its tidal tributaries when the lighter, warmer, and fresher water coming downstream from the spring rains overlays the denser, colder, and saltier water of the salt wedge bringing water upstream from the ocean ⁶

rain barrel: a barrel used as a cistern to hold rainwater ¹

rain garden: specially designed gardens that are placed in low-lying areas, where they capture stormwater runoff, as well as trap and filter pollutants with the soil and roots of the plants ¹⁶

rebuttal: a statement which says that a claim or criticism is not true ¹⁹

recreational activities: things to participate in as a way of enjoying yourself when you are not working ¹⁹

regulatory: to control or direct by a rule, principle, method ¹

reptiles: any cold-blooded vertebrate of the class Reptilia, comprising the turtles, snakes, lizards, crocodylians, amphisbaenians, tuatara, and various extinct members including the dinosaurs ¹

residential: land use that is primarily for houses, townhouses, apartments, or other dwelling types ⁶

respiration: the metabolic processes by which an organism takes in and uses oxygen and releases carbon dioxide and other waste products ²⁵

restoration: the act or process of bringing something back to a previous condition or position ¹¹

retention pond: a manmade pond where stormwater is directed and held ²⁶

ridgeline: a line marking or following a ridgetop ³

riparian area: refers to the area of land adjacent to a body of water, stream, river, marsh, or shoreline; forms the transition between the aquatic and the terrestrial environment ²

riparian forest buffer: an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water which is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife ²

ripple effect: a spreading effect or series of consequences caused by a single action or event ¹

root: the usually underground part of a seed plant body; functions as an organ of absorption, aeration, and food storage or as a means of anchorage and support ³

runoff: that part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water; it can carry pollutants from the air and land into receiving waters ⁴

rural: living in or characteristic of farming or country life ¹

salinity: a measure of the salt concentration of water; higher salinity means more dissolved salts; usually measured in parts per thousand ²

sapling: a loose term for a young tree no longer a seedling but not yet a pole ¹⁰

sapwood: the younger, softer living or physiologically active outer portion of wood that lies between the cambium and the heartwood and is more permeable, less durable, and usually lighter in color than the heartwood ³

sediment: matter that settles and accumulates on the bottom of a body of water or waterway ²

sediment fence: a temporary sediment barrier consisting of a synthetic filter fabric stretched across and attached to supporting posts and entrenched; frequently used in disturbed areas to prevent sediment from leaving the site ²⁷

sedimentary rock: rock formed by the accumulation of sediment such as clay, silt, sand, or gravel that is cemented by natural processes; also rock formed by the natural precipitation and cementation of substances such as calcium carbonate from seawater ¹¹

sedimentation: the separation of suspended particles from water by gravity that causes diminished or loss of flow in watercourses ²

seed: the fertilized, matured ovule of a flowering plant, containing an embryo or rudimentary plant ¹

seedling: a tree grown from seed that has not yet reached a height of 0.9 m (three feet) or exceeded 5.1 cm (two inches) in diameter at breast height, which would qualify it as a sapling ¹⁰

sequestering: to take temporary possession of ¹

sewage: liquid and solid waste carried off in sewers or drains ¹

sewage treatment plant: a facility designed to receive the wastewater from domestic sources and to remove materials that damage water quality and threaten public health and safety when discharged into receiving streams or bodies of water ²⁸

sewer: a system of underground pipes that collect and deliver wastewater to treatment facilities or streams ²⁸

shale: a sedimentary rock formed by the deposition of successive layers of clay ¹

silt: sedimentary materials composed of fine or intermediate-sized mineral particles ⁴

silviculture: the art and science of growing and tending forest vegetation, i.e., controlling the establishment, composition, and growth of forests, for specific management goals ¹⁰

simple leaf: a single leaf blade with a bud at the base of the leafstem

slash and burn agriculture: characterized or developed by felling and burning trees to clear land, especially for temporary agriculture ³

soil: the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants ⁹

spawn: to produce offspring in large numbers ¹

species: an aggregation of individuals alike in appearance and structure which mate and produce fertile offspring ¹⁰

spur: these are the slender, tubular projections of the petals or sepals of some flowers ⁸

stakeholder: individuals that are affected by or involved in a process or function and that have a vested interest in the process or function ⁹

steward (environmental steward): a person who is responsible to take care of our natural resources to ensure that they are sustainably managed for current and future generations ⁴

stomata: the pores on a plant's stem or leaf, which through opening and closing, control the exchange of gases with the outside ⁸

storm drain stenciling: a method of labeling storm drains with a message to remind the public that what goes down the drain does not disappear and is not necessarily treated before it reaches a body of water ²⁹

stormwater: an abnormal amount of surface water due to a heavy rain or snowstorm ¹

stratification: the formation, accumulation, or deposition of materials in layers, such as layers of fresh water overlying higher salinity water (salt water) in estuaries ²

stream piracy: natural diversion of the headwaters of one stream into the channel of another stream having greater erosional activity and flowing at a lower level ³⁰

strip cropping: cultivation of crops in strips following the contours of the land to minimize erosion ¹

strip mining: removal of soil and rock above a layer or seam (particularly coal), followed by the removal of the exposed mineral ⁴⁸

structural BMPs: physical devices typically designed and constructed to trap or filter pollutants from runoff, or reduce runoff velocities ³¹

submerged aquatic vegetation (SAV): rooted vegetation that grows underwater in shallow zones where light penetrates; also known as "Bay grasses" ²

sub-watershed: a land area (basin) bounded by ridges or similar topographic features, encompassing only part of a watershed ¹⁰

suspended particles: solid organic or inorganic particles that are held in suspension in a solution ¹⁴

sustainable: of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged ³

tannin: any of various compounds, including tannic acid, that occur naturally in the bark and fruit of various plants ¹

tectonic: relating to, causing, or resulting from structural deformation of the earth's crust ³²

teeth: a small, notched projection along a margin, especially of a leaf ¹

terminal bud: a bud growing at the tip of a branch or stem ⁸

terrestrial: living on land, as opposed to marine or aquatic ²

testimony: evidence in support of a fact or statement; proof ¹

tidal: of or pertaining to tides; caused by tides; having tides; periodically rising and falling, or following and ebbing ¹⁷

topography: the shape of the land in terms of elevation, slope and orientation ³³

tourism: the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business, and other purposes ³⁷

towpath: historically, a path which goes along the side of a river or a canal, and which was used in the past by horses pulling boats ¹⁹

toxic chemical: a poisonous substance capable of causing injury or death ¹

translocation: the movement of soluble materials within a plant; common examples are the movement of food materials from the leaves to storage organs, and the movement of dissolved minerals upward from the roots ³⁹

transpiration: process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, such as leaf pores ²⁸

tributary: a body of water flowing into a larger body of water ²; for example, the Monocacy River is a tributary of the Potomac River

tributary strategies: detailed implementation plans to achieve the nutrient and sediment cap load allocations; developed in cooperation with local watershed stakeholders ²

trunk: the main stem of a tree, apart from limbs and roots ³

turbidity: the decreased clarity in a body of water due to the suspension of silt or sedimentary material ²

turbulence: unstable flow of a liquid or gas ¹

understory: just beneath the canopy, this layer of the forest is composed of small trees and shrubs. ²

urban: relating to or concerned with a city or densely populated area ¹

velocity: the rate of speed with which something happens; rapidity of action or reaction ¹

viable: capable of growing or developing ¹

watershed: the area of land that drains into a particular body of water, such as a stream, river, lake, or bay; its boundaries are determined by points of high elevation, often corresponding with ridges

wetland: low areas such as swamps, tidal flats, and marshes which retain moisture ²

xylem: a compound tissue in vascular plants that helps provide support and that conducts water and nutrients upward from the roots, consisting of tracheids, vessels, parenchyma cells, and woody fibers ¹

zinc: a ductile, bluish-white metallic element; used in making galvanized iron, brass, and other alloys ¹

zooplankton: a community of floating, often microscopic animals that inhabit aquatic environments; unlike phytoplankton, zooplankton cannot produce their own food, and so are consumers ²

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