Food safety in school gardens and greenhouses

# How to keep you and your garden or greenhouse healthy

Eating fresh fruits and vegetables that have germs on them can make you sick. Germs can get onto fruits and vegetables when they come into contact with animal droppings, human waste, dirty water, and dirty tools. Luckily, there are steps you can take to keep your produce free from germs and keep you and your garden/greenhouse healthy.

# Choose the location of your garden carefully

If you are thinking about building a school garden, consider the location:

1. Make sure your garden isn’t located near a well, septic system, in-ground tank, or dumpster.
2. Avoid low-lying areas where water can collect. Vegetables grow better in well-drained soils.
3. Avoid damaging underground pipes and wires by contacting “Miss Utility” 1-800-257-7777.

# Test your soil

Soils can contain lead, which can be harmful, particularly for children. Private and university labs can evaluate lead levels in your soil. All soils will have a natural level between 5 and 40 ppm. School gardens should not be located in areas with a soil lead level above 300 ppm. Soil that has been commercially packaged and labeled for growing food can be purchased.

# Know the rules

Check with your school’s administrator to determine whether or not your school is following any particular food safety regulations. These regulations set specific guidelines about areas of concern such as composting, water quality, animals, and post-harvest procedures.

# Compost safety

If you plan to compost, consider using green waste like grass clippings, flower clippings, or leaves. Do not use manure, pet waste, or food scraps, as these can contain harmful germs. When handling compost it is important to wear gloves and wash your hands afterwards. Commercially-produced compost made from manure is safe to use.

# Water sources

You should know the quality of the water source that you’ll use in the garden or greenhouse. If your water is from a municipal or public water system, it is probably safe. If your school uses well water, the water should be tested at least once a year. Private and university labs can evaluate water samples.

# Rain barrels

Watering your garden or greenhouse using rainwater collected in barrels can be a good way to teach students about sustainability, but it is important to keep in mind that this water can be contaminated with harmful germs and heavy metals. As a result, some precautions should be taken to make sure that the water is safe and that you aren’t spreading these germs and metals onto your plants.

Barrels should be cleaned with a 3% bleach solution before collecting water. A 5-6% unscented household bleach solution should be added at a rate of 1/8 teaspoon (8 drops) per gallon of water. A typical 55 gallon rain barrel would need approximately one ounce of bleach on a monthly basis. Water may need to be treated up to twice a month if there is frequent rainfall. Wait until the next day to use the water so the bleach has time to dissipate. Note that bleach labeled specifically for water treatment may be required, depending on any food safety certifications the garden or garden may have.

Avoid wetting the plant with water from rain barrels. Instead, try to water the soil or use drip irrigation. As an additional precaution, avoid watering late in the day as sunlight and wind can help get rid of germs on leaves.

# Pest management

Do not use synthetic pesticides in school gardens or greenhouses.

Some plants have a natural ability to repel pest. Consider planting: basil to repel flies, carrot flies, asparagus beetles and mosquitoes. Catnip for ants, flea beetles, and weevils.

# Wildlife

## in your garden

If animals such as deer, rabbits, groundhogs, etc. are disturbing your garden, consider obtaining permission, funding, and assistance to build a fence with a gate around your garden. If deer are the problem, the fence will need to be at least 8 ft. tall. If not able to buy a 8ft./have room for a 8 ft,, a 4 ft. fence will be enough. Not only will a fence prevent animals from eating your vegetables, it will also prevent animal droppings from coming into contact with your food. Reduce nesting and hiding places for rats and mice by keeping the grass mowed in and around your garden. Cover the tops of stakes and posts with objects to keep birds from resting and leaving droppings in and around your garden. Consider using a owl decoy.

## in your greenhouse

Rodents can be problematic in greenhouses. Reduce nesting and hiding places by keeping floors clean around plants and/or keeping plants on pallets or tables. Keep birds out by enclosing your greenhouse.

# Chickens

Chicken litter can harbor harmful germs. To avoid spreading these germs to your garden, do not locate chicken coops close to gardens. Chickens should not be allowed near or in the gardens. As litter can collect on the soles of shoes, avoid going from chicken coops to gardens. Children should not touch the chickens and should wash their hands after any interactions with them.

# Harvesting your produce

Harvest containers should be clean and made from materials designed for safely holding food and, if used repeatedly, easy cleaning. Wash your hands before picking produce. If using gloves, make sure that they are clean. Brush, shake, or rub off excess garden soil and/or debris before putting produce into harvest containers.

# Washing your produce

While washing your produce can help minimize the risk of consuming harmful germs, careless use of water can spread germs from one piece of produce to all of the other pieces of produce. Rinsing produce with single pass water or using a sanitizer in tank water is recommended.

# Storing your produce

Keep produce bins in the refrigerator clean. Use a thermometer to check that your refrigerator is at 40 degrees Fahrenheit or less. Produce stored at room temperature should be kept in cool, dry, pest-free, well-ventilated areas away from chemicals.

# Do i need a license?

There are no mandatory requirements for produce so there is no requirement for a license or GAP certification to be an approved source for produce. If you want verification that your practices are optimal for food safety, the Maryland Department of Agriculture offers a no cost GAP inspection program.

# Glossary

**Agricultural Tea**-A water extract of biological materials (such as stabilized compost, manure, non-fecal animal by products, peat moss, pre-consumer vegetative waste, table waste, or yard trimmings), excluding any form of human waste, produced to transfer microbial biomass, fine particulate organic matter, and soluble chemical components into an aqueous phase. Agricultural teas are held for longer than one hour before application. Agricultural teas are soil amendments for the purpose of this rule.

**Agricultural Tea Additive**- A nutrient source (such as molasses, yeast extract, or algal powder) added to agricultural tea to increase microbial biomass.

**Animal Intrusion**- Wildlife or other animal activity in produce growing and handling areas that leaves observable evidence in the form of animal feces, urine, tracks, or crop damage. Animal intrusion should be evaluated during the growing season and immediately prior to harvest to minimize risks of produce contamination from animal fecal material that may contain human pathogens.

**Aquaculture**- The breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean. Researchers and aquaculture producers are "farming" all kinds of freshwater and marine species of fish, shellfish, and plants. Aquaculture produces food fish, sport fish, bait fish, ornamental fish, crustaceans, mollusks, algae, sea vegetables, and fish eggs.

**Aquaponics**- Aquaponics merges two farming technologies – aquaculture and hydroponics. Aquaculture is the farming of fish, crustaceans, mollusks and aquatic plants. Hydroponics is growing plants only in water, not soil. Aquaponics is a symbiotic relationship, where fish waste ammonia is converted by bacteria into nitrites and then into nitrates. The plants absorb the nitrates as fertilizer, and clean water is pumped back to the fish.

**Bacteria-** Single-cell microorganisms without distinct nuclei or organized cell structures**.**

**Biofilm**- A complex structure of different microorganisms adhering to a surface and protected by glue-like carbohydrates, secreted by the microorganisms. Once the microorganisms attach to food contact surfaces as a biofilm, they are very difficult to completely remove.

**Biological Soil Amendment-** Any soil amendment containing biological materials such as stabilized compost, manure, non-fecal animal byproducts, peat moss, pre-consumer vegetative waste, sewage sludge biosolids, table waste, agricultural tea, or yard trimmings, alone or in combination.

**Biological Soil Amendment of Animal Origin**- A biological soil amendment which consists, in whole or in part, of materials of animal origin, such as manure or non-fecal animal byproducts including animal mortalities, or table waste, alone or in combination. The term “biological soil amendment of animal origin” does not include any form of human waste.

**Cleaning-** Physical removal of dirt (soil) from surfaces which can include the use of clean water and detergent.

**Clean Break-** A break in production where all the food contact surfaces on the production line are cleaned and sanitized with a documented, verified, and validated process.

 **Colony Forming Unit (CFU)-** A measure of viable cells quantifying the number of bacteria in a sample based on an analysis that measures how many visible, viable colonies (large mass of bacterial growth) form when a liquid sample (or sample dilution) is placed onto an Agar surface for growth. This calculation is based on the assumption that each colony stems from the deposition of a single bacterial cell onto the agar surface that divides over several generations. Results are reported in CFU/100 mL. Co-Management Practices that minimize the risk of fecal contamination and resulting microbiological hazards associated with food production while simultaneously conserving and protecting soil, water, air, wildlife, and other natural resources.

**Come-Up Time-** The time to achieve the appropriate temperature in a composting system for the reduction or elimination of harmful microorganisms.

**Communicable-** Able to be transmitted from one person to another; contagious or infectious.

**Composting**- A process to produce stabilized compost in which organic material is decomposed by the actions of microorganisms under thermophilic conditions for a designated period of time (for example, 3 days) at a designated temperature (for example, 131°F (55 °C)), followed by a curing stage under cooler conditions.

**Contamination-** The unintended presence in food of potentially harmful substances, including microorganisms, chemicals, and physical objects.

**Corrective Actions -**Actions taken to correct a problem and identify why it occurred in order to prevent it from happening again. Some corrective actions can be anticipated ahead of time if a problem is likely to occur. For example, a corrective action can be outlined for what to do after animal intrusion into a field, including the actions workers need to take to reduce food safety risks. These prevention-oriented corrective actions should be documented in the Farm Food Safety Plan.

**Cross-Contamination-** Contamination of one food item with microbial pathogens from another food item, water, surface, or other object. Sources of cross-contamination may include pathogens transferred to produce through contaminated wash or irrigation water, improperly applied manure, animal feces, packing lines, worker hands, harvest bins, or trucks.

**Cull Pile**-A pile of discarded plant material or produce. Cull piles may become an attractant to pests or a source of nutrients for the growth of bacterial pathogens.

**Curing**- The final stage of composting, which is conducted after much of the readily metabolized biological material has been decomposed, at cooler temperatures than those in the thermophilic phase of composting, to further reduce pathogens, promote further decomposition of cellulose and lignin, and stabilize composition. Curing may or may not involve insulation, depending on environmental conditions.

**Detergent-** A cleaning agent that contains surfactants that reduce surface tension between food surfaces and dirt (soil) or other debris. Detergents aid in lifting dirt off of surfaces. Detergents are used in the cleaning process before a sanitizer.

**Direct Water Application Method-** Using agricultural water in a manner whereby the water is intended to, or is likely to, contact covered produce or food contact surfaces during use of the water.

**Dropped Covered Produce-** Covered produce that drops to the ground before harvest. Dropped covered produce does not include root crops that grow underground such as carrots, crops that grow on the ground such as cantaloupe, or produce that is intentionally dropped to the ground as part of harvesting such as almonds. Covered produce unintentionally dropped to the ground during harvest is also considered dropped covered produce

**Farm Food Safety Plan-** A written document that outlines the farm’s food safety practices and may include recordkeeping logs, Standard Operating Procedures, and other supporting documents that help growers implement food safety practices.

**Floating row cover; row cover, or garden fabric-**Material that can help protect plants from cold and wind, or deter insects and other pests, as well as keeping soil and plants from overheating.

**Food Contact Surfaces**- The surfaces that contact human food and those surfaces from which drainage, or other transfer, onto the food or onto surfaces that contact the food ordinarily occurs during the normal course of operations. This includes food contact surfaces of equipment and tools used during harvest, packing and holding.

**Foodborne Illness Outbreak-** The occurrence of two or more cases of illness resulting from eating or drinking the same foods contaminated with the same pathogen. In the case of botulism, only one illness is required to be recognized as an outbreak.

**Geometric Mean (GM)-** A measure of the central tendency of your microbial water quality data, the average of log-transformed values. The geometric mean is a required criterion of the Microbial Water Quality Profile for agricultural water.

**Good Agricultural Practices (GAPs)-** Any agricultural management practice or operational procedure that reduces microbial risks or prevents contamination of fruits and vegetables on the farm or in packing areas.

**Good Manufacturing Practices (GMPs)-** Standards to ensure the safety of foods by outlining sanitary standards and practices for production and handling.

**Green Waste-** Biodegradable waste that may be composed of garden or farm waste, such as grass, flower cuttings, hedge trimmings, as well as domestic and commercial plant-based food waste. Green waste cannot be considered zero risk since it may contain physical, chemical, or biological hazards. If the green waste contains any materials of animal origin, including animal feces, it cannot be considered green waste.

**Grey Water-** All other domestic and industrial wastewater.

**Ground Water**- The supply of fresh water found beneath the Earth’s surface, usually in aquifers, which supply wells and springs. Ground water does not include any water that meets the definition of surface water.

**Growth Media**- Material that acts as a substrate during the growth of covered produce (such as mushrooms and some sprouts) that contains, may contain, or consists of components that may include any animal waste (such as stabilized compost, manure, non-fecal animal byproducts or table waste). Liquid-only matrices are not considered to be growth media.

**Harvesting**- Harvesting applies to farms and farm mixed-type facilities and means activities that are traditionally performed on farms for the purpose of removing raw agricultural commodities from the place they were grown or raised and preparing them for use as food. Harvesting is limited to activities performed on raw agricultural commodities, or on processed foods created by drying/dehydrating a raw agricultural commodity without additional manufacturing/processing, on a farm. Harvesting does not include activities that transform a raw agricultural commodity into a processed food. Examples of harvesting include cutting (or otherwise separating) the edible portion of the raw agricultural commodity from the crop plant and removing or trimming part of the raw agricultural commodity (e.g., foliage, husks, roots or stems). Examples of harvesting also include cooling, field coring, filtering, gathering, hulling, removing stems and husks from, shelling, sifting, threshing, trimming of outer leaves of, and washing raw agricultural commodities grown on a farm.

**Hazard**- Any biological agent that has the potential to cause illness or injury in the absence of its control.

**Hazard Analysis Critical Control Point (HACCP)-** A process that identifies critical control points (CCPs) where contamination can occur and manages these points as a way of ensuring the safety of the products being produced. HACCP requires processes be monitored at all times and be corrected if the processes exceed the established critical control points. HACCP is commonly used in processing plants but not considered appropriate in fresh produce fields because the necessary level of control is not achievable.

**Home Garden and Information Center (HGIC)**- Develop and deliver science-based, sustainable gardening and integrated pest management education for better human and environmental health.  **Visits to extension.umd.edu/hgic**

**Hydroponics**- The practice of growing plants in water, rather than in soil.

**Inorganic Fertilizer-** A chemical fertilizer of synthetic or mineral origin.

**Lot-** A distinct and limited portion of the crop that can be grouped and identified. For small farms, it may be all the tomatoes harvested by one work crew on the same day from the same field that received similar inputs (e.g., soil amendments, irrigation water, protective sprays).

**Known or Reasonably Foreseeable Hazard**- A biological hazard that is known to be, or has the potential to be, associated with the farm or in the food.

**Maryland Department of Agriculture (MDA)**- . . .to provide leadership and support to agriculture and the citizens of Maryland by conducting regulatory, service, and educational activities that assure consumer confidence, protect the environment, and promote agriculture.​

**Manure**- Animal excreta, alone or in combination with litter (such as straw and feathers used for animal bedding) for use as a soil amendment.

**Master Gardener (MG)**- The University of Maryland Extension Master Gardener Program began in 1978 as a means of extending the horticultural and pest management expertise of University of Maryland Extension to the general public. This program is designed to train volunteer horticultural educators.

* Educating the public at community events and fairs
* Developing and maintaining demonstration gardens
* Speaking to a wide range of community groups, beginning gardeners and youth
* Advising and answering questions about gardening techniques and plant problems at plant clinics
* Using whatever special skills (writing, photography, evaluation, graphic design, etc.) they might have to benefit the community and the program.

**Microorganisms**- Microorganisms means yeasts, molds, bacteria, viruses, protozoa, and microscopic parasites and includes species having public health significance. The term ‘‘undesirable microorganisms’’ includes those microorganisms that are of public health significance, that subject food to decomposition, that indicate that food is contaminated with filth, or that otherwise may cause food to be adulterated.

**Monitor**- To conduct a planned sequence of observations or measurements to assess whether a process, point or procedure is under control and, when required, to produce an accurate record of the observation or measurement.

**Most Probable Number (MPN)-** A statistical estimate of the number of bacteria in a sample determined through laboratory analysis. Results are reported in MPN/100 mL.

**Pathogen**- A microorganism (bacteria, parasites, viruses) that causes disease in humans.

**Personal Hygiene**-Individual cleanliness and habits.

**No-Harvest Buffer Zone-** A defined distance around an identified risk from which produce should not be harvested. No harvest buffer zones can be established around fecal contamination or around areas of significant animal intrusion to minimize the risk of harvesting produce that has been contaminated.

**Non-Fecal Animal Byproduct**- The solid waste (other than manure) that is animal in origin (such as meat, fat, dairy products, eggs, carcasses, blood meal, bone meal, fish meal, shellfish waste (such as crab, shrimp, and lobster waste), fish emulsions, and offal) and is generated by commercial, institutional, or agricultural operations.

**Non-Food Contact Surface-** Surface that does not contact produce directly, but may contribute to the risk of contamination of fruits and vegetables. For example, brush rollers on a sorting or grading table that contact produce directly are considered direct food contact surfaces whereas a gear box attached to the rollers that does not come into contact with produce would be considered a non-food contact surface.

**Parts Per Million (PPM)**-A way of expressing very dilute concentrations of substances; in this document it refers to chemical concentration, such as the amount of sanitizer. One ppm is equivalent to 1 milligram (or milliliter) of a chemical per liter of water (mg/L).

**Pathogen-** A disease-causing microorganism, or other microorganism of public health significance.

**Pest**- Any objectionable animal or insect, including birds, rodents, flies, and larvae.

**Personal Protective Equipment (PPE)-** Equipment worn to minimize exposure to a variety of hazards. Examples of PPE include items such as gloves, eye protection, hearing protection devices (earplugs, muffs), hard hats, respirators, and full body suits.

**Policy** A statement that explains practices aimed at achieving a specific food safety outcome. Policies are specific to each farm. Policies should be included in the Farm Food Safety Plan.

**Postharvest Handling** Any practices that occur during or after harvest including cooling, culling, washing, and packing.

**Postharvest Water** Water that meets the definition of agricultural water and is used during and after harvest of covered produce, or during postharvest handling of covered produce; this can include agricultural water used during harvest activities in the field as well as during packing or holding activities, such as water used in a packinghouse.

**Potable** Meets the Environmental Protection Agency (EPA) primary drinking water standards including microbiological quality.

**Pre-Consumer Vegetative Waste**- Solid waste that is purely vegetative in origin, not considered yard trash, and derived from commercial, institutional, or agricultural operations without coming in contact with animal products, byproducts or manure or with an end user (consumer). Pre-consumer vegetative waste includes material generated by farms, packing houses, canning operations, wholesale distribution centers and grocery stores; products that have been removed from their packaging (such as out-of-date juice, vegetables, condiments, and bread); and associated packaging that is vegetative in origin (such as paper or corn-starch based products). Pre-consumer vegetative waste does not include table waste, packaging that has come in contact with materials (such as meat) that are not vegetative in origin, or any waste generated by restaurants.

**Risk Assessment-** A process to identify potential hazards on a farm and/or in a packinghouse as well as the likelihood the hazards will impact the safety of fruits and vegetables.

**Runoff**-Rainwater, leachate, or other liquid that drains over land, leaves the land surface, and enters unintended areas such as streams, fields, or packing areas.

**Safety Data Sheets (SDS) (previously Material Safety Data Sheets (MSDS))-** Documents that contain information on the potential health effects of exposure to chemicals, or other potentially dangerous substances, and on safe working procedures when handling chemical products. SDS are specific to each substance and are provided by the manufacturer.

**Sanitize**- To adequately treat cleaned surfaces by a process that is effective in destroying vegetative cells of microorganisms of public health significance, and in substantially reducing numbers of other undesirable microorganisms, but without adversely affecting the product or its safety for the consumer.

**Sanitizer-** A substance that reduces the amount of microorganisms to acceptable levels, typically for use on food contact surfaces. Sanitizers are generally considered to be part of a broader group of substances called antimicrobial pesticides. The antimicrobial product label will describe approved uses, such as for water or for food contact surfaces, as well as approved concentrations or dosages.

**School Gardens-** Gardens and/or greenhouses located on school property thatare used for nutrition,agriculture, and experiential education across all disciplines. School gardens can also include more complex systems, spanning container gardens to greenhouses, aquaponics, etc. on school grounds.

**Sewage Sludge Biosolids**- The solid or semi-solid residue generated during the treatment of domestic sewage in a treatment works within the meaning of the definition of “sewage sludge”.

**Side-Dressing-** Application of a soil amendment to the side of the planted crop row so the nutrients are available in the root zone without damaging the plant.

**Single Pass Water-** Water that passes over produce only once, as with a hose, faucet, or sprinkler. The water is not reused.

**Soil Amendment**- Any chemical, biological, or physical material (such as elemental fertilizers, stabilized compost, manure, non-fecal animal byproducts, peat moss, perlite, pre-consumer vegetative waste, sewage sludge biosolids, table waste, agricultural tea and yard trimmings) intentionally added to the soil to improve the chemical or physical condition of soil in relation to plant growth or to improve the capacity of the soil to hold water. The term soil amendment also includes growth media that serve as the entire substrate during the growth of covered produce (such as mushrooms and some sprouts).

**Standard Operating Procedure (SOP)-** Written description of an activity and how to properly complete the activity. An SOP should specify all the materials needed to complete the activity, the frequency with which the activity is conducted, and how to document the activity. An SOP may also include which employees are responsible for completing the activity and provide corrective actions to mitigate the problems that are likely to happen. Stabilized Compost\* A stabilized (i.e., finished) biological soil amendment produced through a controlled composting process.

**Static Composting**- A process to produce stabilized compost in which air is introduced into biological material (in a pile (or row) that may or may not be covered with insulating material, or in an enclosed vessel) by a mechanism that does not include turning. Examples of structural features for introducing air include embedded perforated pipes and a constructed permanent base that includes aeration slots. Examples of mechanisms for introducing air include passive diffusion and mechanical means (such as blowers that suction air from the composting material or blow air into the composting material using positive pressure).

**Surface Water**- All water open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

**Table Waste**- Any post-consumer food waste, irrespective of whether the source material is animal or vegetative in origin, derived from individuals, institutions, restaurants, retail operations, or other sources where the food has been served to a consumer.

**Tank Water-** A volume of water inside of a container such as a bin, bucket, tank, etc.

**Template-** Samples of recordkeeping logs, SOPs, and language to aid in the development of a Farm Food Safety Plan. Templates must be edited to reflect activities on the specific farm represented in the Farm Food Safety Plan.

**Total Coliforms, Fecal Coliforms, and *Escherichia coli* (*E. coli*)-** Coliforms are bacteria that are found in the environment, soil and intestines of warm-blooded animals. Fecal coliforms are a type of coliform that are more likely to be specifically associated with human or animal fecal material and are a more accurate indication of the presence of feces than total coliforms. *Escherichia coli* (*E. coli*) is within the group of fecal coliforms. Generic *E. coli* is considered to be the most likely species within the fecal and total coliforms to indicate that the water may contain fecal contamination and is designated as the indicator organism to meet the agricultural water criteria in the FSMA Produce Safety Rule.

**Traceability-** The ability to track a food product through the food production and distribution system. In the case of fruits and vegetables, this includes back to the field where it was grown and any subsequent handling, storage, and sale.

**Turbidity-** The cloudy appearance of water when suspended sediments such as soil and organic matter are present. The level of turbidity is measured in Nephelometric Turbidity Units (NTU). Turbidity is one measurement that can be used to monitor postharvest water for buildup of organic material, and help growers establish an appropriate water-change schedule.

**Turned Composting**- A process to produce stabilized compost in which air is introduced into biological material (in a pile, row, or enclosed vessel) by turning on a regular basis. Turning is the process of mechanically mixing biological material that is undergoing a composting process with the specific intention of moving the outer, cooler sections of the material being composted to the inner, hotter sections.

**University of Maryland Extension (UME)**- University of Maryland Extension is a statewide, non-formal education system within the college of Agriculture and Natural Resources and the University of Maryland Eastern Shore. UME educational programs and problem-solving assistance are available to citizens and are based on the research and experience of land grant universities such as the University of Maryland, College Park.

**Visitor**- Any person (other than personnel) who enters your farm with your permission.

**Water Distribution System**- A system to carry water from its primary source to its point of use, including pipes, sprinklers, irrigation canals, pumps, valves, storage tanks, reservoirs, meters, and fittings.

**Worker-** Any person, paid or unpaid, working on a farm .

**Yard Trimmings**- Purely vegetative matter resulting from landscaping maintenance or land clearing operations, including materials such as tree and shrub trimmings, grass clippings, palm fronds, trees, tree stumps, untreated lumber, untreated wooden pallets, and associated rocks and soils.

# resources

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