Rain Garden Lesson Guide Correlations by Grade

Grade Level	Study Area	Benchmark	Performance Indicator	No Place to Run	Capture, Store, and Release	How Deep Will It Flow	Put on Your Design Cap	Get Down and Dirty	Measuring Up
3	Earth and Space Sciences	C: Describe Earth's resources including rocks, soil, water, air, animals, and plants and the ways in which they can be conserved.	C4. Observe and describe the composition of soil (e.g. small pieces of rock and decomposed pieces of plants and animals and the products of plants and animals)			X			
3	Earth and Space Sciences	C: Describe Earth's resources including rocks, soil, water, air, animals, and plants and the ways in which they can be conserved.	C5. Investigate the properties of soil (e.g. color, texture, capacity to retain water, and ability to support plant growth).	X	X	x			X
3	Earth and Space Sciences	C: Describe Earth's resources including rocks, soil, water, air, animals, and plants and the ways in which they can be conserved.	C6.Investigate that soil is often found in layers and can be different from place to place.			X			
3	Life Sciences	C: Compare changes in an organism's ecosystem/ habitat that affect survival.	C6. Describe how changes in an organism's habitat are sometimes beneficial and sometimes harmful.						X
3	Science and Technology	A: Describe how technology affects humans.	A2. Describe ways that using technology can have helpful and/or harmful results.					X	X
3	Science and Technology	B. Describe and illustrate the design process.	B4. Use a simple design process to solve a problem (e.g. identify the problem, identify possible solutions, and design a solution).	X	X		X		
3	Scientific Inquiry	A: Use appropriate instruments safely to observe, measure, and collect data when conducting scientific investigations.	A1. Select the appropriate tools and use relevant procedures to measure and record length and weight using metric and English measurements,	X	X				X
3	Scientific Inquiry	B. Organize and evaluate observations, measurements, and other data to formulate references and conclusions.	B5. Record and organize observations (e.g. journals, charts, and tables)	X	X	X	X		X
3	Scientific Inquiry	C: Develop, design, and safely conduct scientific investigations and communicate the results.	C6. Communicate scientific findings to others using a variety of methods (e.g. pictures, written, oral, and recorded observations.)	X	X		X		X
3	Scientific Ways of Knowing	B: Describe different types of investigations and use results and data from the investigations to provide evidence to	B1. Describe different kinds of investigations that scientists use depending on the questions they are trying to answer.						X

		support explanations and conclusions.							
3	Scientific Ways of Knowing	C: Explain the importance of keeping records of observations that are accurate and understandable.	C2. Keep records of investigations and observations and do not change records that are different from someone else's work.	X	X	X	X		X
4	Earth and Space Sciences	D. Analyze weather and changes that occur over a period of time.	D4. Describe weather by measurable quantities such as temperature, wind direction, precipitation, and barometric pressure	X	XX				X
4	Earth and Space Sciences	D. Analyze weather and changes that occur over a period of time.	D5. Record local weather information on a calendar or map and describe changes over a period of time (e.g. barometric pressure, temperature, precipitation symbols, and cloud conditions)						X
4	Life Sciences	B: Analyze plant and animal structures and functions needed for survival and describe flow of energy through a system that all organisms use to survive.	B2. Relate plant structures to their specific functions (e.g. growth, survival, and reproductions)				X		X
4	Science and Technology	B. Describe and illustrate the design process.	B5. Describe, illustrate, and evaluate the design process to solve a problem.	X	X		X		X
4	Scientific Inquiry	A. Use appropriate instruments safely to observe, measure, and collect data when conducting scientific investigations.	A1. Select the appropriate tools and use relevant procedures to measure and record length, weight, volume, temperature, and area using metric and English measurements	X	X				C
4	Scientific Inquiry	C: Develop, design, and safely conduct scientific investigations and communicate the results.	C3. Develop, design, and conduct safe, simple investigations or experiments to answer questions.	X	X				C
4	Scientific Ways of Knowing	C: Explain the importance of keeping records of observations that are accurate and understandable.	C2. Record the results and data from an investigation and make a reasonable explanation.	X	X	X	X		X
4	Scientific Ways of Knowing	C: Explain the importance of keeping records of observations that are accurate and understandable.	C3. Explain discrepancies in an investigation using evidence to support findings.	X	X				X
4	Scientific Ways of Knowing	C: Explain the importance of keeping records of observations that are accurate and understandable.	C4. Explain why keeping records or observations and investigations are important.	X	X				

5	Earth and Space Sciences	C: Describe Earth's resources including rocks, soil, water, air, animals, and plants and the ways in which they can be conserved.	C6. Investigate ways Earth's renewable resources (e.g. fresh water, wildlife, and trees) can be maintained.				X		
5	Life Sciences	C: Compare changes in an organism's ecosystem/ habitat that affect survival.	C6. Analyze how all organisms, including humans, cause changes in their ecosystems and how these changes can be beneficial, neutral, or detrimental.	X	X		X		X
5	Science and Technology	A: Describe how technology affects humans.	A1. Investigate positive and negative impacts of human activity and technology on the environment.						X
5	Science and Technology	B. Describe and illustrate the design process.	B3. Explain how the solution to one problem may create other problems.						X
5	Scientific Inquiry	A: Use appropriate instruments safely to observe, measure, and collect data when conducting scientific investigations.	A1. Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g. thermometers, timers, balances, spring scales, magnifiers, microscopes, and other appropriate tools.)	X	X			X	X
5	Scientific Inquiry	B. Organize and evaluate observations, measurements, and other data to formulate references and conclusions'.	B3. Use evidence and observations to explain and communicate the results of investigations.	X	X	X	X		X
5	Scientific Inquiry	B. Organize and evaluate observations, measurements, and other data to formulate references and conclusions.	B6. Explain why the results of an experiment are sometimes different.	X	X	X			X
5	Scientific Ways of Knowing	A: Distinguish between fact and opinions and explain how ideas and conclusions change as new knowledge is gained.	A3. Explain why an experiment must be repeated by different people or at different times or places and yield consistent results before the results are accepted.			X			X
5	Scientific Ways of Knowing	C: Explain the importance of keeping records of observations that are accurate and understandable.	C5. Keep records of investigations and observations that are understandable weeks or months later.					X	X
5	Earth and Space Sciences	D: Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are	D1: Describe the rock cycle and explain that there are sedimentary, igneous, and metamorphic rocks that have distinct properties (e.g. color, texture,) and are formed in			X			

		formed and/or classified.	different ways.						
6	Life Sciences	D. Explain how extinction of a species occurs when the environment changes and its adaptive characteristics are insufficient to allow survival (as seen in evidence of the fossil record).	D8. Describe how organisms interact with one another.				X		X
6	Science and Technology	A: Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.	A1. Explain how technology influences the quality of life.					X	
6	Science and Technology	A: Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.	A2. Explain how decisions about the use of products and systems can result in desirable or undesirable consequences (e.g. social and environmental)	X				X	X
6	Science and Technology	B. Design a solution or product taking into account needs and constraints (e.g. costs, time, trade-offs properties of materials, safety and aesthetics).	B5. Design and build a product or create a solution to a problem given one constraint.				X	X	
6	Scientific Inquiry	A. Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations, and appropriate tools.	A1. Explain that there are not fixed procedures for guiding a scientific investigations, however the nature of the investigation determines procedures needed.		X				X
6	Scientific Inquiry	A. Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations, and appropriate tools.	A2. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations.	X		X			X
6	Scientific Ways of Knowing	A. Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation.)	A1. Identify that hypotheses are valuable event when they are not supported.				X		X
6	Scientific Ways of Knowing	B. Explain that importance of reproducibility and reduction of bias in scientific methods.	B2. Describe why it is important to keep clear, thorough, and accurate records.						X

7	Earth and Space Sciences	C. Describe how the interactions of mater and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g. water cycle, weather, and pollutions).	C2. Explain that Earth's capacity to absorb and recycle materials naturally can change environmental quality depending on the length of time involved.	X	X	X			
7	Earth and Space Sciences	C. Describe how the interactions of mater and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g. water cycle, weather, and pollutions).	C4. Describe how rivers, lakes, and groundwater can be depleted or polluted becoming less hospitable or unsuitable for life.	X					
7	Earth and Space Sciences	C. Describe how the interactions of mater and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g. water cycle, weather, and pollutions).	C7. Read weather maps to interpret local, regional, and national weather.		X				X
7	Earth and Space Sciences	C. Describe how the interactions of mater and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g. water cycle, weather, and pollutions).	C9. Describe the connection between the water cycle and weather related phenomena (floods).	X	X				X
7	Science and Technology	A. Give examples of how technological advances influences by scientific knowledge alter the quality of life.	A1. Explain how needs, attitudes, and values influence the direction of technological developments in various cultures.			X			X
7	Science and Technology	B. Design a solution or product taking into account needs and constraints.	B4. Design and build a product or create a solution to a problem given two constraints.				X	X	
7	Scientific Inquiry	A. Explain that there are differing set of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations, and appropriate tools.	A1. Explain that variables and controls can affect the results of an investigation and that ideally one variable should be tested at a time; however that is not always possible.		X	X			X
7	Scientific Inquiry	A. Explain that there are differing set of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations, and	A4. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations.		X	X			X

		appropriate tools.							
7	Scientific Ways of Knowing	B. Explain the importance of reproducibility and reduction of bias in scientific methods.	B3. Describe how the work of science requires a variety of human abilities and qualities that are helpful in daily life (e.g. reasoning, creativity, skepticism, and openness)	X			X	X	X
8	Earth and Space Sciences	C. Describe how the interactions of mater and energy throughout the lithosphere, hydrosphere, and atmosphere (e.g. water cycle, weather, and pollutions).	C11. Use models to analyze the size and shape of the earth, its surface and its interior (e.g. globes, topographic maps, and satellite images	X		X	X		
8	Life Sciences	D. Explain how extinction of a species occurs when the environment changes and its adaptive characteristics are insufficient to allow survival (as seen in evidence of the fossil record).	D3. Explain how variations in structure, behavior, or physiology allow some organisms to enhance their reproductive success and survival in a particular environment						X
8	Science and Technology	A. Give examples of how technological advances influences by scientific knowledge alter the quality of life.	A2. Examine how choices regarding the use of technology are influenced by the constraints caused by various unavoidable factors (e.g. geographic location, limited recourses, social, political, and economic considerations)	X		X	X		
8	Science and Technology	B. Design a solution or product taking into account needs and constraints.	A3: Design and build a product or create a solution to a problem given more than two constraints (Grade 8)				X	X	
8	Science and Technology	B. Design a solution or product taking into account needs and constraints.	A4. Evaluate the overall effectiveness of a product design or solution						X
8	Scientific Inquiry	A. Explain that there are differing set of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations, and appropriate tools.	A1. Choose appropriate tools or instruments and use relevant safety procedure to complete scientific investigations		X	X			X
8	Scientific Inquiry	B. Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.	B3. Read, construct and interpret data in various forms produced by self and other in both oral and written form		X	X			X

8	Scientific Ways of Knowing	A. Use skills of the scientific inquiry process.	A1. Identify the difference between a description and an explanation.						X
8	Scientific Ways of Knowing	B. Explain the importance of reproducibility and reduction of bias in scientific methods.	B2. Explain why I is important to examine data objectively and not let bias affect observations.				X		X
9	Earth and Space Sciences	F: Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and Space sciences.	F8: Use historical examples to explain how new Ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings and usually grow slowly through contributions from many different investigators (e.g. heliocentric theory and plate tectonics theory).						X
9	Physical Sciences	C: Describe the identifiable physical properties of substances (e.g. color, hardness, conductivity, density, concentration, and ductibility). Explain how changes in these properties can occur without changing the chemical nature of the substance.	C9: Investigate the properties of pure substances and mixtures (e.g. density, conductivity, hardness, properties of alloys, superconductors, and semiconductors).				X		X
9	Science and Technology	A: Explain the ways in which the processes of technological design respond to the needs of society.	A2: Identify a Problem or need, propose designs and choose among alternative solutions for the problem.	X		X	X		
9	Science and Technology	A: Explain the ways in which the processes of technological design respond to the needs of society.	A3: Explain why a design should be continually assessed and the ideas of the design should be tested, adapted, and refined.	X		X			
8	Science and Technology	B: Explain that science and technologies are interdependent; each drives the other.	B1: Describe means of comparing the benefits with the risks of technology and how science can inform public policy.						X
9	Scientific Inquiry	A: Participate in and apply the process of scientific investigation to create models and to design, conduct, evaluate, and communicate the results of these investigations.	A1: Distinguish between observations and inferences given a scientific situation.						X
9	Scientific Inquiry	A: Participate in and apply the process of scientific investigation to	A2: Research and apply appropriate safety precautions when designing and conducting						X

		create models and to design, conduct, evaluate, and communicate the results of these investigations	scientific investigations (e.g. OSHA, Material Safety Datasheets (MSDS).						
9	Scientific Inquiry	A: Participate in and apply the process of scientific investigation to create models and to design, conduct, evaluate, and communicate the results of these investigations	A4: Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those inputs.		X	X			X
9	Scientific Inquiry	A: Participate in and apply the process of scientific investigation to create models and to design, conduct, evaluate, and communicate the results of these investigations	A5: Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps, and available technology.	X		X			X
9	Scientific Inquiry	A: Participate in and apply the process of scientific investigation to create models and to design, conduct, evaluate, and communicate the results of these investigations	A6: Draw logical conclusions based on scientific knowledge and evidence from investigations.	X	X	X	X		X
9	Scientific Ways of Knowing	A; Explain the scientific knowledge must be based on evidence, be predictive, logical, subject of modification and limited to the natural world.	A3: Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions.		X				X
9	Scientific Ways of Knowing	B: Explain how scientific inquiry is guided by knowledge, observations, ideas, and questions.	B6: Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data.						X
9	Scientific Ways of Knowing	B: Explain how scientific inquiry is guided by knowledge, observations, ideas, and questions.	B7: Recognize that scientific knowledge and explanations have changed over time; almost always building on earlier knowledge.						X
9	Scientific Ways of Knowing	C: Describe ethical practices in science (e.g. individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias.	C2:			X			X

9	Scientific Ways of Knowing	D: Recognize that scientific literacy is a part of being a knowledgeable citizen.	D8: Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work, and their efforts to advance scientific knowledge in their area of study.						X
9	Scientific Ways of Knowing	D: Recognize that scientific literacy is a part of being a knowledgeable citizen.	D9: Investigate how the knowledge, skills, and interests learned in the science classes apply to the careers students plan to pursue.		X	X			
10	Earth and Space Sciences	D: Describe the finite nature of Earth's resources and those human activities that can conserve of deplete Earth's resources.	D5: Explain how the acquisition and use of resources, urban growth, and waste disposal can accelerate natural change and quality of life.						X
10	Earth and Space Sciences	D: Describe the finite nature of Earth's resources and those human activities that can conserve of deplete Earth's resources.	D6: Describe ways that human activity can alter biochemical cycles (e.g. carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g. pest control, legume rotation of crops vs. chemical fertilizers).	X					X
10	Life Sciences	F: Explain the structure and function of ecosystems and relate how ecosystems change over time.	F15: Explain how living things interact with biotic and abiotic components of the environment (e.g. predation, completion, natural disasters and weather.				X		X
10	Life Sciences	F: Explain the structure and function of ecosystems and relate how ecosystems change over time.	F16: Relate how distribution and abundance of organisms are limited by the ability of the ecosystem to recycle materials and the availability of matter, space and energy.				X		X
10	Life Sciences	G: Describe how human activities can impact the status of natural systems.	G18: Describe ways that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. Explain how changes in technology/biotechnology can cause significant changes either positive or native, in environmental quality and carrying capacity.	X			X		X
10	Life Sciences	G: Describe how human activities can impact the status of natural systems.	G19: Illustrate how uses of resources at locate, state, regional, national, and global levels have affected the quality of life (e.g. energy production and sustainable vs. nonsustainable agriculture.					X	

10	Science and Technology	A: Explain the ways in which the processes of technological design respond to the needs of society.	A3: Explain that when evaluating a design for a device or process, thought should be given to how it will be manufactured, operated, maintained, replaces, and disposed of in addition to who will sell, operate, and take care of it. Explain how the cost associated with these considerations may introduce additional constraints on the design.	X	X		X		X
10	Science and Technology	B: Explain that science and technologies are interdependent; each drives the other.	B1: Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need to meet human needs and solve problems.			X	X		
10	Science and Technology	B: Explain that science and technologies are interdependent; each drives the other.	B2: Describe examples of scientific advances and emerging technologies and how they may impact society.				X		
10	Science Inquiry	A. Participate in and apply the processes of scientific investigation to create models and to design, construct, evaluate and communicate the results of these investigations.	A2: Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology	X	X	X			X
10	Science Inquiry	A. Participate in and apply the processes of scientific investigation to create models and to design, construct, evaluate and communicate the results of these investigations.	A3: Use mathematical modals to predict and analyze phenomena.	X	X	X	X		X
10	Science Inquiry	A. Participate in and apply the processes of scientific investigation to create models and to design, construct, evaluate and communicate the results of these investigations.	A4: Draw conclusions from inquiries based on scientific principals, the use of logic and evidence (data) from investigations.	X	X	X	X		X
10	Scientific Ways of Knowing	D: Recognize that scientific literacy is a part of being a knowledgeable citizen.	D7: Investigate how the knowledge, skills, and interests learned in the science classes apply to the careers students plan to pursue.				X		
11	Earth and Space Sciences	B: Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other	B3: Explain heat and energy transfers in and out of the atmosphere and its involvement in weather and climate (radiation, conduction, convection, and advection).						X

		systems.							
11	Earth and Space Sciences	C: Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.	C9: Explain the effects biomass and human activities have on climate (e.g. clean change and global warming).			X			X
11	Earth and Space Sciences	C: Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.	C11: Analyze how materials from human societies (e.g. radioactive waste and air pollution) affect both physical and chemical cycles of Earth.						X
11	Earth and Space Sciences	C: Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.	C12: Explain ways in which humans have had a major effect on other species (e.g. the influence of humans on other organisms through land use which decreases the space available to other species and pollution which changes the chemical composition of air, soil, and water.				X		X
11	Earth and Space Sciences	C: Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.	C13: Explain how human behavior affects the basic processes of natural ecosystems and the quality of the atmosphere, hydrosphere, and lithosphere.	X			X		X
11	Life Sciences	A: Describe how processes at the cellular level affect the functions and characteristics of an organism.	A1: Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of pathogens.			X	X		X
11	Life Sciences	B: Explain how humans are connected to and impact natural systems.	B5: Investigate the impact on the structure and stability of ecosystems due to changes in their biotic and abiotic components as a result of human activity.	X			X		X
11	Life Sciences	F: Explain how human choices today will affect the quality and quantity of life on earth.	F9: Give examples of how human activity can accelerate rates of natural changes and can have unforeseen consequences.				X		X
11	Life Sciences	F: Explain how human choices today will affect the quality and quantity of life on earth.	F11: Investigate issues of environmental quality at local, regional, national, and global levels such as population growth, resource use, population distribution, over	X			X		

			consumption, the capacity of technology to solve problems, poverty, the role of economics, politics, and different ways humans view the earth.						
11	Science and Technology	A: Predict how human choices today will determine the quality and quantity of life on earth.	A1: Identify that science and technology are essential social enterprises but alone they can only indicate what can happen, not what should happen. Realize the latter involves human decisions about the use of knowledge.				X		
11	Science and Technology	A: Predict how human choices today will determine the quality and quantity of life on earth.	A2: Predict how decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment and/or humans.	X					
11	Science and Technology	A: Predict how human choices today will determine the quality and quantity of life on earth.	A3: Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g. new varieties of farm plants and animals that have been engineered by manipulating their genetic instructions to reproduce new characteristics).						X
11	Science Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A1: Formulate testable hypothesis. Develop and explain appropriate procedures, controls, and variables (dependant and independent) in scientific experimentation.		X	X			X
11	Science Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A2: Evaluate assumptions that have been used in reaching results.						X
11	Science Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating	A3: Design and carry out scientific inquiry (investigation), communicate, and critique results through peer review.			X		X	X

		conclusions from our data							
11	Science Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data	A4: Explain why the methods of an investigation are based on the questions being asked.			X			X
11	Science Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A5: Summarize data and construct a reasonable argument based on those data and other know information.		X	X			
11	Scientific Ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A1: Analyze a set of data to derive a hypothesis and apply that hypothesis to a similar phenomenon (e.g. biome data).			X			X
11	Scientific Ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A2: Apply scientific inquiry to evaluate the results of scientific investigations, observations, theoretical models and the explanations proposed by other scientists.			X			X
11	Scientific Ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A3: Demonstrate that scientific explanations adhere to established criteria, for example a proposed explanation must be logically consistent, it must abide by the rules of evidence, and it must be open to questions and modifications.			X			X
11	Scientific Ways of Knowing	C: Explain how societal issues and considerations affect the progress of science and technology.	C9: Explain how natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by human bring benefits to society as well as risks.	X			X		X
12	Life Sciences	B: Explain how humans are connected to and impact natural systems.	B7: Relate diversity and adaptation to structure and functions of living organisms at various levels of organization.				X		X
12	Life Sciences	D: Relate how biotic and abiotic global changes have occurred in the past and will continue to	D8: Based on the structure and stability of ecosystems and their nonliving components, predict the biotic and			X			X

		do so in the future	abiotic changes in such systems when they are disturbed (e.g. introduction of non-native species, climatic change, etc.).						
12	Physical Sciences	E. Summarize the historical development of scientific theories and ideas within the study of physical sciences.	E14: Use historical examples to explain how new ideas are linked by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many investigators (e.g. nuclear energy, quantum theory, and theory of relativity.)				X		X
12	Science and Technology	A: Predict how human choices today will determine the quality and quantity of life on earth.	A3: Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems.			X	X		X
12	Science and Technology	A: Predict how human choices today will determine the quality and quantity of life on earth.	A4: Explain why basic concepts and principals of science and technology should be part of active debate about the economics, politics, and ethics of various science-related and technology related challenges.	X			X		
12	Scientific Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A1: Formulate testable hypotheses. Develop and explain the appropriate procedures, controls, and variables (dependant and independent) in scientific experimentation.			X			X
12	Scientific Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A2: Derive simple mathematical relationships that have predictive power from experimental data (e.g. derive and equation from a graph and vise versa, determine whether a linear or exponential relationship exists among data in a table.)	X	X	X			X
12	Scientific Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data	A3: Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g. OSHA, MSDS, eyewash, goggles, and ventilation).						X

		and formulating conclusions from our data.							
12	Scientific Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A4: Create and clarify the method, procedures, controls and variables in complex scientific investigations.						X
12	Scientific Inquiry	A: Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from our data.	A5: Use appropriate summary statistic to analyze and describe data.	X	X	X			X
12	Scientific ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A2: Evaluate scientific investigations by reviewing current scientific knowledge and experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations.			X			X
	Scientific ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A3: Select a scientific mode, concept, or theory and explain how it has been revised over time based on new knowledge, perceptions, and technology.				X		X
	Scientific ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A4: Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g. predator prey relationships and properties of semiconductors).			X			X
	Scientific ways of Knowing	A: Explain how scientific evidence is used to develop and revise predictions, ideas, or theories.	A8: Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them.	X			X		

	Scientific ways of Knowing	C: Explain how societal issues and considerations affect the progress of science and technology.	C9: Recognize the appropriateness and value of basic questions "what can happen?" "What are the odds," and "How do scientists and engineers know what will happen?"			X			X

TOPOGRAPHIC MAP ORIENTAION ACTIVITY

*Name:*_____ *Date:*_____

Using the 7.5-minute topographic map that includes your school and the USGS brochure "Topographic Map Symbols," complete the exercise below. You may use a grease pencil provided to mark your answers on the laminated map.

1. ***Map Scales**:*
- Find the scale on the map. What scale is the map? _____
- How many miles is it from your school to the nearest town? Use an index card and measure from your school to a specific intersection in the nearest town)_____

1. *Contours:* Locate the nearest stream to your school
- What is the elevation of the stream nearest to your school where the first tributary downstream enters?_____
- Find the closest point of either the Little Miami River, East Fork of the Little Miami River, or other major river to your school. What is the elevation?_____

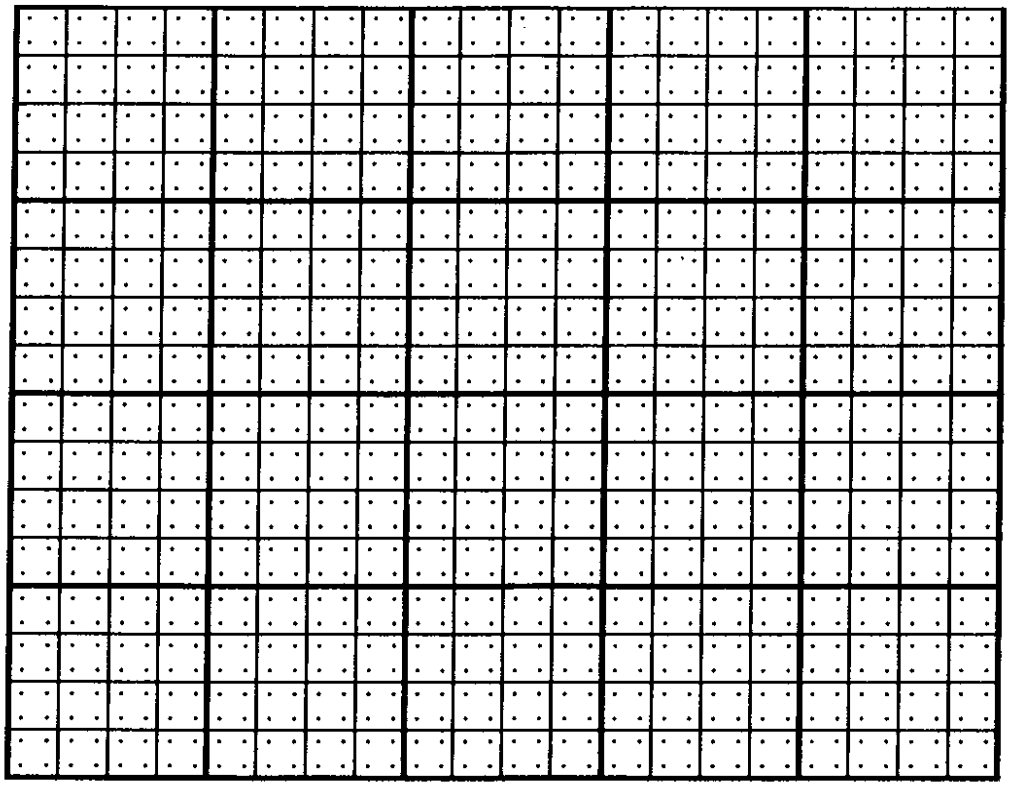
2. Orientation:
- Find the nearest city to your school on the map._____
- Draw the closest route by car from the school to the nearest city. How many miles is it?_____

3. *Rivers:*
- Where does closest creek to your school enter either the Little Miami River, East Fork of the Little Miami River, or other major river? Give nearest intersection or landmark._____
- Where does the closest creek to your school go under a bridge?_____

4. ***Symbols (Note: If your map does not contain one of the symbols in this list, leave the line blank)**:*
- Is there a wetland near your school? Give a location in longitude and latitude._____
- Is there a sink hole near your school? Give a location in longitude and latitude._____
- What is the name of the closest school and/ or church to your school?_____
- Find a park on your map and give the closest intersection._____
- Is there a wastewater treatment plant near your school? Name it._____
- Is there a factory near your school? Name it._____
- Locate some railroad tracks near your school._____
- Name the 2 four lane highways that appear on the map._____
- Find the closest pond to your school._____

Source: Greenacres Foundation Make A Splash Training Manual, 1999.

DOT GRID



Map scales and equivalents

Fractional Scale	Acres Per Square Inch	Acres Per Dot
1: 24,000 (1 inch = 2,000 ft)	91.8	1.43
1: 100,000 (1 inch = 8,333 ft)	1594.0	24.9

1. Clearly draw line around area to be estimated.
2. Place dot grid randomly over area to be estimated.
3. Count all dots fully within the area plus every other dot that falls on the line around the area.
4. Record the total number of dots.
5. Repeat three times, randomly placing grid each time.
6. Take average of dot counts.
7. Multiply by appropriate acres/dot factor.

NOTE: Areas larger than dot grid may be estimated by breaking them down into smaller areas, then totaling the number of dots in each area.

Source: TVA Student Water Quality Network Teacher Training Manual, March 1992.

CALCULATING RUNOFF WORKSHEET

Student Name_____ Date_____

To calculate the amount of runoff that drains to a proposed rain garden site at the school for a specific amount of rainfall, the drainage area needs to be measured first and then the volume calculated using a specific or actual rainfall amount.

1) **Drainage Area**. (ft. x ft = sq. ft., add all types for total)

a. Pervious Surfaces _____ft. X _____ft = _____sq. ft.
(Lawn, landscape beds, and woodland

b. Impervious Surfaces _____ft. X _____ft = _____sq. ft.
(Paved surfaces)

c. Roof Area _____ft. X _____ft = _____sq. ft.

TOTAL _____sq. ft.

2) **Rainfall** (in. /12in=ft) _____in. / $\frac{1\text{ ft}}{12\text{ in}}$. = _____ft.

3) **Runoff Volume** (sq.ft. x ft. = cu.ft.) _____sq. ft. x ____ft = _____cu. ft.
(Note: sq. ft is the area and ft is the rainfall.)

4) **Gallons** (1 cu.ft. = 7.48 gallons) _____cu.ft. X 7.48 gal = _____gal.

***FACTOID**: An average 5 minute shower uses 25 gallons. An average 400 sq.ft. (0.5 ft. deep) rain garden captures 1500 gallons of water or 60 showers!*

SIZING A RAIN GARDEN WORKSHEET - MIDDLE SCHOOL

Name:_____ Date:_____

To determine the size of the rain garden, complete this worksheet.

1) Drainage Area: Measure your drainage area.

a. Roof area: _____feet X _____feet = _____square feet
b. Lawn area: _____feet X _____feet = _____square feet
c. Paved surfaces:_____feet X _____feet = _____square feet

Total drainage area: _____**square feet**

2) Soil Type: Determine your soil type using Soil Texture by Feel Key.
Please circle: sand silt/loam clay

Rain Garden Depth: Use **ONE** of the two methods below Slope **OR** Soil Factor.

2a) Slope:		**Depth:**
a. Less than a 4% slope	=	3 – 5 inch deep rain garden
b. 5 – 7% slope	=	6 – 7 inch deep rain garden
c. 8 – 12% slope	=	8 inch deep rain garden

OR

2b) Soil Factor: Use the appropriate table below to find your soil factor. The soil factor**s** derived from soil type and rain garden depth.

Table #1: Rain gardens up to 30 feet from a downspout.

	4 inches	6 inches	8 inches
Sandy soil	0.19	0.15	0.08
Silty Soil	1.35	0.25	0.06
Clayey Soil	0.43	0.32	0.20

Table #2: Rain gardens more than 30 feet from the downspout.

	4 inches	6 inches	8 inches
Sandy soil	0.03	0.03	0.03
Silty Soil	.06	0.06	0.06
Clayey Soil	0.10	0.10	0.1

3) Rain Garden Depth: _____**inches deep**

3b) Rain Garden Size: Multiply total drainage area (#1) by the Slope Percentage depth (#2a) or Multiply total drainage area (#1) by soil factor (#2b).

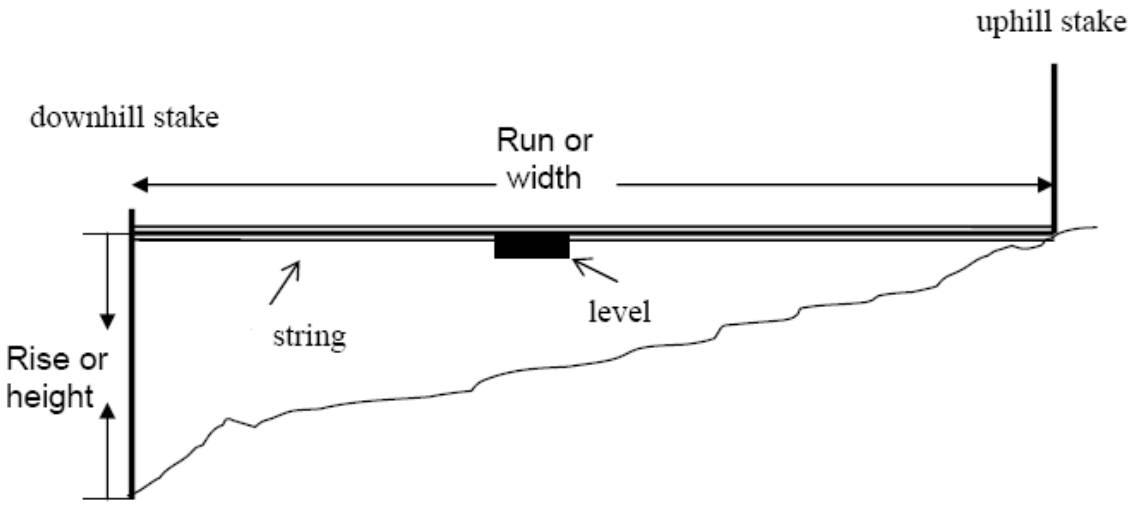
_____(sq ft.) total drainage area X _____soil factor = _____**(sq ft.) rain garden**

**Adapted from Earth Partnership for Schools, University of Wisconsin*

SLOPE HANDOUT

Directions for measuring the slope

1. Hold the stake with the string attached at the uphill end of the measuring site. Push the string down to the bottom of the uphill stake.
2. Place the second stack at the downhill end.
3. Run the string to the downhill stake. You may need to move the stake to meet the string. The distance between the stakes is 10 feet or 120 inches. Write this number as the run on the field sheet.
4. Loop the string around the downhill stake.
5. Attach the line level to the string. It should hang down. Slide the string up or down on the downhill stake until the line level indicates the string is horizontal and level
6. Measure the height in inches on the downhill stake between the string and ground. Write this number as the rise on the field sheet.
7. If desired, repeat at a different site and trade roles.
8. Back in the classroom, calculate slope and determine depth of rain garden.



The percent slope is calculated by measuring the change in height (elevation) over a measured distance. The following formula determines slope:

Rise ÷ Run x 100 = Slope %
OR
(Change in elevation ÷ measured distance x 100 = slope %)

For example: 23‘ ÷ 100‘ x 100 = 23%

**Adapted from Earth Partnership for Schools, University of Wisconsin*

RUNOFF COEFFICIENTS

Land use - Description	Color Code for Map	Storm Runoff coefficient
Open water	Blue	0.00
Low density residential	Pink	0.40
Urban	Red	0.70
Bare rocks/sand/clay	Brown	0.80
Forest	Dark Green	0.15
Grasslands/herbaceous/shrub lands	Yellow Green	0.25
Crops/farmlands	Yellow	0.40
Urban/recreational grasses	White	0.20
Wetlands	Olive Green	0.05

Source: Indiana Geological Survey

SIZING A RAIN GARDEN WORKSHEET – HIGH SCHOOL

Name:_____ Date:_____

R = CAI

R = Rain Garden size (cubic feet)
C = runoff coefficient representing a ratio of runoff to rainfall
A = drainage area contributing to the rain garden location from Dot Grid (convert acres to feet)
I = average rainfall (inches/day expressed in feet)

C: Runoff Coefficients Representing a Ratio of Runoff to Rainfall

Land use - Description	**Storm Runoff coefficient**
Open water	0.00
Residential	0.40
Urban	0.70
Rock/sand/clay	0.80
Forests	0.15
Grasslands/shrubs	0.25
Crops	0.40
Recreational grasses	0.20
Wetlands	0.05

CxA: Drainage Area contributing runoff times runoff coefficients:.

a. Open Water: _____acres X 1.43 X 0.00 = _____square feet
b. LD Residential: _____acres X 1.43 X 0.40 = _____square feet
c. Urban: _____acres X 1.43 X 0.70 = _____square feet
d. Rocks/sand/clay: _____acres X 1.43 X 0.80 = _____square feet
e. Forest: _____acres X 1.43 X 0.15 = _____square feet
f. Grasslands/shrubs: _____acres X 1.43 X 0.25 = _____square feet
g. Crops: _____acres X 1.43 X 0.45 = _____square feet
h. Recreational grasses:____acres X 1.43 X 0.20 = _____square feet
Total drainage area: _____**square feet**

I: Average Rainfall:

Largest Storm Event 1: _____average inches /day
Smallest Storm Event 2: _____average inches /day
Mean Storm Event 3: _____average inches /day
Average Rainfall: _____/3 = _____/12 = _____**feet/day**

R: Rain Garden Size (volume to hold average day of rainfall)

_____Total drainage area X _____Average rainfall = _____cubic feet

HOW TO CONDUCT A PERK TEST

STEPS:

1. Dig 8“diameter and 8” deep hole with a trowel.
2. Fill hole with water and let saturate for an hour.
3. Refill Hole and use pencil jabbed in side of hole to mark top of water level.
4. Use ruler to measure distance from the pencil to top of water. Visit the hole every hour or so until it drains completely. Measure it each time but only use one measurement and time for the calculation, preferably the last measurement.
5. Calculate how much water will infiltrates in inches per hour. . The goal is a Rain Garden that will drain in 24 hours.

   _____Inches/_____time (in hours) = _____Inches/hr.

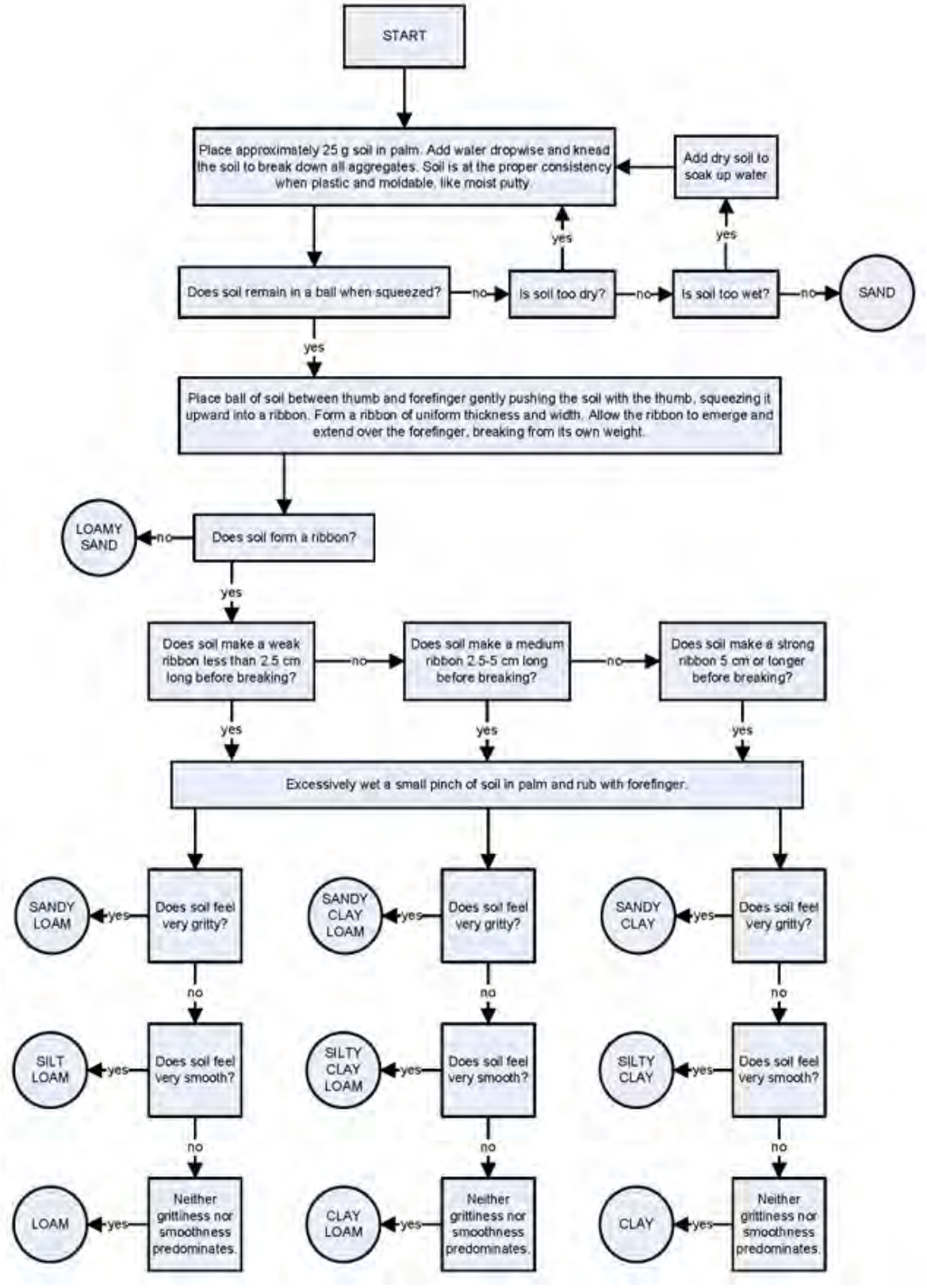
   Example:
   0.5 inches/ 90 minutes (convert 90 minutes to1.5 hr) = 0.33 inches per hour

6. Use perk test results to select a depth for the rain garden that will drain in 24 hours.

   If your garden drains 0.33 inches per hour, in 24 hours it will drain 7.92 inches. So your rain garden should not exceed 8 inches deep.

Photo Source: Rusty Schmidt, Washington Soil and Water Conservation District, Minnesota, Wisconsin

KEY TO SOIL TEXTURE BY FEEL



Modified from S.J. Thien. 1979. A flow diagram for teaching texture by feel analysis. *Journal of Agronomic Education. 8:54-55.*

PLANT WORKSHEET

Name_____ Date_____

Plant Name:_____

Botanic Name:

Sun Shade Preference:_____

Moisture Requirements:_____

Will plant survive inundation with water?_____

Bloom Color:_____

Bloom Time:_____

Fall Color:_____

Other Ornamental Features
(seed, fruit, bark, etc.):_____
_____

Relationship to theme: (wildlife habitat,
butterfly habitat, edible plant, scent plant, etc)_____
_____
_____
_____

Plant Photo or Drawing:

PLANT EVALUATION TABLE

Name_____ Date_____

Plant Name	Botanic Name	Height	Spread	Sun/ Shade Preference	Moisture Requirements	Will survive standing water?	Bloom Color	Bloom Time	Fall Color	Other Ornamental feature	Use in Theme (optional)

RAIN GARDEN SPECIES SELECTION CRITERIA WORKSHEET

Name_____**Date:**_____

Location: _____**Size:** _____ **(sq ft)**

Environmental Conditions:

Circle the site characteristics that describe your site.

Soil Type:	Sand	Silt/Loam	Clay
Percent Slope:	less than 4%	5% - 7%	8% - 12%
Light:	Full sun	Partial shade	Shade

Rain Garden Specifications

Complete section below based on site conditions and your rain garden design goals.

Garden Size (sq.ft.)_____**Number of plants needed (1 plant/square foot):**_____

Ecosystem type (Habitat): Prairie (sun) Savanna (part sun) Woodland (shade)

Desired plant type(s): (circle all that apply.)

Grasses Sedges Wildflowers Ferns
Shrubs Trees Other_____

Height Requirements: Minimum height:_____Maximum height:_____

Desired Bloom Times:

____Spring (April – May) ____Early Summer (June),
____Summer (July) ____Late Summer (August),
____Fall (September – October)

Additional Criteria

Identify criteria that fit your project goals such as flower color, texture, fragrance, wildlife value, etc.

_____
_____
_____
_____
_____

Adapted from Earth Partnership for Schools, University of Wisconsin

MEASURING UP
EXAMPLE BUTCHER PAPER PLANT SUCCESS RECORD

Plant Name	**Week 1 Rainfall Amount:** 0.0 inches	**Week 3 Rainfall Amount:** 0.0 inches	**Week 3.5 Rainfall Amount:** 0.5 inches	**Week 5 Rainfall Amount:** 0.0 inches
Black-eyed Susan	Healthy and growing	Healthy and Growing	No Change	Flowering
Indian Grass	No change	Healthy and Growing	No Change	No change
Sweet Shrub	No Change	No Change	No change	Rabbit damage

RESOURCES

RESOURCES SITED IN LESSON GUIDE:

The Blue Thumb Guide to Raingardens by Rusty Schmidt, Dan Shaw, and David Dods, Waterdrop Innovations, LLC, 2007.

City of Maplewood. Rain Garden Design and Construction Worksheet. Maplewood: City of Maplewood, 2007.

Creek Connections Topographic Map Module:
http://creekconnections.allegheny.edu/Modules/TopographicMaps.html

Degrees, Minutes, Seconds and Decimal Degrees Latitude/Longitude Conversions:
http://www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html

Earth Partnership For Schools – University of Wisconsin:
http://uwarboretum.org/eps/research_act_classroom/rain_garden_curriculum.php

A flow diagram for teaching texture by feel analysis, S.J. Thien. Journal of Agronomic Education. 8:54-55, 1979.

Free online landscape design software like http://www.showoff.com/; or *free trials of landscaping programs* such as www.ideaspectrum.com.

Give Water A Hand, http://www.uwex.edu/erc/gwah/

A How-to Manual for Homeowners. Board of Regents of the University of Wisconsin System. Rain Gardens: UWEX Publication, 2003.

Runoff Coefficients Table, Indiana Geological Survey:
http://igs.indiana.edu/survey/projects/hydrotools/html_files/element2.cfm.

Rain Gardens A How to Manual for Homeowners, UW-Extension offices, Cooperative Extension Publications, University of Wisconsin,, 2003 .

Start-to-Finish Rain Garden Design A Workbook for Homeowners, Faribault County Soil & Water Conservation District with funding from MPCA and 319.

Terra Server, http://terraserver-usa.com/ or
http://mapserver.mytopo.com/homepage/index.cfm?CFID=3692819&CFTOKEN=19169154.

TVA Teacher Student Monitoring Network Teacher Training Manual, Tennessee Valley Authority, 1992.

Undeveloped vs Developed Infiltration Rates illustration, Stream Corridor Restoration: Principals, Processes, and Practices, Federal Interagency Stream Restoration Working Group (FISRWG). October 1998.

Watershed Woes, activity, Environmental Resources Guide: Nonpoint, Grades 9-12, Air and Waste Management Association, 1993.
http://secure.awma.org/OnlineLibrary/ProductDetails.aspx?ProductID=87

PRINTED RESOURCES *(Distributed to Teacher in Clermont OEEF Project):*

The Blue Thumb Guide to Raingardens
Locally these books can be purchase for $18.00 from the Greater Cincinnati Rain Garden Alliance by calling (513) 563-8800. The book is also for sale through www.Amazon.com; search for Rain Garden and this is the first book that comes up. You can also purchase the book from: www.TerraceHorticulturalBooks.com.. For bulk orders of 10 or more copies, visit www.Raingardens@yahoo.com or call Rusty Schmidt at 612-703-8695. This book is published by Water Drop Innovations Inc.

Plants for Storm Water Design (Volumes I and II)
Volume I and Volume II are both available. Volume I is $15.95 and Volume II is $27.95. There is a discount if you order both; Volume I and II combined is $34.95. These prices do NOT include tax or shipping/handling. They take major credit cards. To order, visit this website to obtain and order form: http://www.greatrivergreening.org/publications.asp. Then fax the order to them at: 651-665-9409.

WEB_BASED RESOURCES:

Cincinnati Zoo and Botanical Garden Regional Plant Places Rain Garden Plant Database: http://www.plantplaces.com/raingardenindex.shtml

Kids Gardening – Rain Garden Activities: http://www.kidsgardening.com/themes/raingarden.asp

LID Sustainable School Projects – Rain Gardens: http://lowimpactdevelopment.org/school/bioret/brm.html

Maplewood, Minnesota Rain Garden Project: http://www.ci.maplewood.mn.us/index.aspx?NID=456

Maplewood: Creating Your Own Rain Garden: http://www.ci.maplewood.mn.us/DocumentView.aspx?DID=247&DL=1

Maplewood Rain Garden Designs: http://www.ci.maplewood.mn.us/index.aspx?NID=457

Northern Rhode Island Conservation District: http://nricd.org/studentlessons.htm

Stormwater Curriculum : http://www.danewaters.com/pdf/stormWaterCurriculum.pdf

Rain Garden Network School Gardens: http://www.raingardennetwork.com/schoolgardens.htm

Rain Gardens a Service Learning Project: http://asstudents.unco.edu/students/AE-Extra/2007/5/Carlson.html

Rain Gardens of Western Michigan: http://www.raingardens.org/Rain_Gardens.php

The Rhodale Kids – Re Gen Page: http://www.kidsregen.org/educators/educators2.php?section=eduNga&ID=11#schoolyard

Teaching With Topographic Maps - 25 Ideas for Educational Lessons: http://rmmcweb.cr.usgs.gov/outreach/topoteach.html

SW OHIO RAIN GARDEN PLANT SOURCES

Greenfield Plant Farms, http://www.greenfieldplantfarm.com/, Phone: (513) 683-5249

J F New (mail order), http://www.jfnew.com/, Phone (574) 586-2412

Keystone Flora, LLC , http://www.keystoneflora.com/, Phone: (513) 961-2727

Marvin's Organic Gardens, http://www.marvinsorganicgardens.com/, Phone: (513) 932-3319

Mary's Plant Farm, http://www.marysplantfarm.com/, Phone: (513) 894-0022

Prairie Moon (catalog), http://www.prairiemoon.com/, Phone: (866) 417-8156

MONITORING EQUIPMENT

Equus 3660 Hand Pump Kit, Part # EQUUS3660, Best Brands, 866-553-8116 or 989-839-4877 , www.Auto-Repair-Manuals.com

Garmin eTrex H Handheld GPS Navigator, Part Number: 010-00631-00, Garmin, 800-800-1020 https://buy.garmin.com/shop/shop.do?cID=143

Garner Industries Basic Rain Gauge, Part # GAI-820-0409, Best Nest, 1-877-562-1818, www.bestnest.com

Hach Just Add Water Level 2 Water Monitoring Kit, Part # 278770, Hach Company, (800) 277-4224, www.hach.com

Hach Phosphate Cube Test Kits, Part #125220, Hach Company, (800) 277-4224, www.hach.com

Hach Nitrate-Nitrogen Cube Test Kit, Part #1403700, Hach Company, (800) 277-4224, www.hach.com

Hach Multi-test Kit Case, Part # 4661000, Hach Company, (800) 277-4224, www.hach.com

HM Digital Economy TDS Meter (TDS-4), HM Digital Water Testing Supplies, 800-383-2777, http://www.tdsmeter.com/products/tds4.html

HM 342 ppm NaCl Calibration Solution, HM Digital Water Testing Supplies, 800-383-2777, http://www.tdsmeter.com/products/tds4.html

Luster Leaf 1880 Rapitest Electronic 4-way analyzer, Luster Leaf Gardening Products Inc., Part # 035307018809, 1-800-327-4635 http://www.lusterleaf.com/Meter/pages/1880.html

Metal Meter/ Yard Stick (Can be purchased at any hardware store)

Topographic Maps, USGS Map Store, 888-275-8747, http://store.usgs.gov/b2c_usgs/b2c/start/(xcm=r3standardpitrex_prd)/.do