NGSS Connections

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Rain Garden Design Challenge
Grade Level: Elementary School

Performance Expectations: Students' ability to complete the following performance expectation(s) will be supported by participation in this activity.

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model of a model or prototype that can be improved.

Dimension	NGSS Code or citation	Corresponding student task in activity
Disciplinary Core Idea	ETS1.A Defining and Delimiting an Engineering Problem • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	During the lab process, students design their models within the constraints of materials, and sometimes cost. For example, they must use all four soils available and build within the space allotted in the model.
	ETS1.B Developing Possible Solutions • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Students use simple models of one soil type per model to test the ability of each soil type to absorb and clean the water. They then use the data from these tests to inform their design of four-soil models of rain gardens.

	• At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Students work in pairs or small groups to design, build and test their first rain garden model. They then discuss their findings with the class and use the class data to redesign, then build and test their new models.
	EST1.C Optimizing the Design Solution • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Student groups design their own models to test, and each model is different from the others. The groups redesign and test a second model. Data is shared between groups, so many solutions are tested to determine the best design for a rain garden to absorb and clean water.
Practices	Developing and Using Models • Identify limitations of models. • Develop and/or use a model to predict and/or describe phenomena.	Students recognize that a limit of the rain garden models is that we do not test their ability to grow plants, one of the criteria for a rain garden design. Students develop and use a model to determine the best combination of soils to absorb and clean water.
	Planning and Carrying out Investigations • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.	Students design their rain garden models and collect data on volume of water absorbed and cleanliness, and use this data to evaluate how well their model met the design goal. They then design and build a second model and compare the results to the first model's results.
Crosscutting Concept	Scale, Proportion, and Quantity	

	• Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.	Students use a small rain garden model to decide the best design to use for a large rain garden. They then observe our real (and large) rain gardens outside.
	Systems and System Models • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.	The students test individual components (four soil types) for absorbing and cleaning water, then construct a model that combines the four soil types, with the goal of achieving the most absorption and the cleanest water.

Nature of Science

Science is a Way of Knowing

- Science is a way of knowing that is used by many people.

Scientific Knowledge is Based on Empirical Evidence

- Scientists use tools and technologies to make accurate measurements and observations.

Science is a Human Endeavor

- Most scientists and engineers work in teams.
- Science affects everyday life.

Connections to Common Core State Standards

English Language Arts/Literacy

ELA-Literacy.W.3-5.2
ELA-Literacy.SL.3-5.1
ELA-Literacy.SL.3-5.4