Sustainable Jersey for Schools

Education for Sustainability Questionnaire

Answer these questions about the **significant lesson** or **set of lessons** that you are submitting for points under the Education for Sustainbility (EfS) action.

1. The lesson(s) must have addressed at least **one** of the **sustainability topics** listed below. *Examples provided under the sustainability topics are meant to be illustrive and not a comprehensive list of subtopics.* Check off the sustainability topic(s) addressed by the lessons, and for which there are documented results:

__X__ Ecological Systems

Investigating natural environmental processes and systems – Learning about the physical and living systems of our planet brings understanding about the interconnectedness and natural limits of these systems and informs solutions to environmental problems. Students can investigate ecological systems at a local level – e.g. biodiversity in the school grounds – or link to studies occuring further away.

____ Climate Change

Acquiring climate literacy – Learning climate science to understand the causes and consequences of global climate change; studying the impact of human activity on the climate and adaptations of man-made and natural systems in the face of climate change. Students can take action to address climate change by reducing their "carbon footprints."

____ Waste

Reducing, reusing, recycling.and cradle-to-cradle design – Re-thinking consumption and product design and use to eliminate the very idea of “waste.” Any school or community can reduce its environmental impact by analyzing the full life cycle of the products it uses, and acting to reduce packaging and transport distance, and to recycle or re-purpose as many items as possible.

____ Energy

Addressing sustainable energy supply and use – Learning about the multiple factors that play a role in energy demand, supply and use and the impacts on ecosystems and socio-economic systems. In some municipalities, schools are the largest energy consumers, but up to 30 percent of that energy may be used inefficiently.

____ Health and Wellness

Addressing issues that impact human health – Eliminating toxic and hazardous materials, while maximizing elements that promote health (e.g. providing clean air and good ventilation, providing clean water, promoting outdoor time and physical activity) will improve the home, work and school environment for everyone.

____ Food Systems

Improving nutrition and food sustainability – Many of the systems for producing, processing, and delivering the food we eat rely on practices that have deleterious effects on the environment, on livestock, on farm workers and on consumers. Choosing local and whole foods impact both human health and the environment.

____ The Built Environment

Addressing transportation, housing, and other infrastucture development – Raise awareness of sustainable solutions such as transportation and development plans that reduce fuel consumption, pollution and car use.

__X__ Water

Addressing water quality, availability, and use – Learning about the water cycle and how use of water and land development in one place impacts water quality and availability in other places.

____Economic Systems

Investigating how economic systems play a role in sustainability – History has seen the collapse of many civilizations whose economic activity degraded the natural and/or social environments. Sustainable economies support a good quality of life for all and maintain healthy ecosystems.

____Social and Cultural Systems

Investigating the impact of social and cultural systems on sustainability – Social and cultural norms influence how different groups interact with each other and with the environment; and these practices are themselves influenced by changes in natural environments .

2. The lesson(s) must have taught about and assessed for at least **one** of the **enduring understandings** of education for sustainability listed below. Check off the enduring understanding(s) that the lesson(s) addressed, and for which there are documented results:

____ A Healthy and Sustainable Future Is Possible

We can learn how to live well within the means of nature. This viewpoint inspires and motivates people to act.

__X__ We Are All In This Together

We are interdependent on each other and on the natural systems.

____ Healthy Systems Have Limits

Rather than exceeding or ignoring the limits, tap the power of limits. Constraints drive creativity.

____ Reconcile Individual Rights with Collective Responsibilities

Responsible and ethical participation and leadership are required in order to make the changes we need to make. We must reconcile the conflicts that exist between our individual rights and our responsibilities as citizens.

____ Diversity Makes Our Lives Possible

Diversity is required to support rich complex systems (like us), to build strength and to develop resilience in living systems. Biological diversity, cultural, gender, political and intergenerational diversity all serve this purpose.

____ Create Change at The Source Not the Symptom

Distinguish problems from symptoms. Identify the most upstream problem you can address within your sphere of influence.

__ __ Think Far into the Future (1,000 Years)

Envision the kind of future we want and start working towards it. We should not sacrifice our children's future to meet our needs.

____ Read the Feedback

We need to pay attention to the results of our behavior on the systems upon which we depend. If we keep our eyes on the feedback, we can adjust our thinking and behavior before we cross detrimental thresholds.

____ It All Begins With a Change In Thinking

Thinking drives behavior and behavior causes results. As Einstein had observed, the significant problems we face cannot be solved with the same level of thinking we used to create them. Think systems, cycles and out of the box.

____ Live By The Natural Laws

We must operate within the natural laws and principles rather than attempt to overcome them. It is nonnegotiable.

__X__ We Are All Responsible

Everything we do and everything we don't do make a difference.

3. Teachers must have used at least **one** of the following **instructional approaches** in conducting the EfS lesson(s). Check off those that apply.

__X__ **Inquiry based**

Students ask questions, plan and carry out investigations, analyze and interpret data, construct explanations and engage in argument based on evidence.

__X__ **Experiential**

Students learn through doing – participating in projects, events, challenges, experiments and other learning activities.

____ **Place-based student learning**

Students participate in investigations and learning activities in school grounds, neighborhoods or natural areas that engage them with real-life scenarios that are tangible, observable and meaningful to them.

____**Interdisciplinary**

2 or more teachers covering different academic disciplines design and/or present related lessons that integrate subject matter from 2 or more academic disciplines (e.g. social studies and science). Indicate New Jersey educational standards met for each discipline in the response to Question 4.

4. Describe the **learning objectives** of the sustainability lessons. Also describe how student learning was **assessed.** These descriptions should indicate the **enduring understanding(s)** of sustainability that were imparted by the lessons, as well as the instructional **approaches** that were used (as checked off above). If the approach was **Interdisciplinary**, please indicate the New Jersey curriculum standards for each discipline that were covered by the lessons:

The unit focuses on the impacts of oil spills and the ways by which environmental engineers clean oil spills and attempt to rectify environmental harm caused by the oil spill. Enduring understandings which the students should understand by the end of the unit include: every organism in the ecosystem is connected, and a change in one population can lead to detrimental changes in other populations; oil spills are a human-caused source of pollution and cause lasting detrimental effects for ecosystems and the environment; environmental engineers work to find solutions when oil spills happen to reduce the detrimental effects of the oil spill.

Inquiry-based and experiential methods were implemented over the course of this unit. Inquiry-based lessons involved students drawing conclusions about scientific phenomena by conducting experiments and analyzing data. For example, one inquiry based lesson involved students creating a food web and analyzing the connections between organisms to see how different populations may be affected by an oil spill. Another inquiry-based lesson involved students testing different materials to see which absorbs oil best, in order to apply the knowledge to the problem-based experiential task of cleaning a model oil spill.

Student learning was assessed using a problem-based experiential project during which students were required to clean a model oil spill and explain how the oil spill could affect an ecosystem in which it would happen. This project was designed to simulate the work of an environmental engineer tasked with cleaning an oil spill. Students applied the engineering design process, through which they investigated what works (and does not work) to remove oil from water, and how the remaining oil in the water could affect the ecosystem by harming populations of the species within the ecosystem.

This unit is based on the Engineering is Elementary curriculum unit “A Slick Solution: Cleaning an Oil Spill” by the Natioanl Center for Tehnological Literacy at the Museum of Science in Boston.

5. Optional: Please share any comments or lessons learned.

Note: As part of the submission requirement you are asked to submit as separate document uploads (see application portal), copies of graded rubrics and student work samples as assessments of student learning that meet/exceeded expectations, and copies of lesson plans. Additional documentation of the lessons such as photographs and news articles may also be submitted.

Environmental Engineering and Oil Spills
STEM Unit Plan
Grade 3

Unit Information	
Unit Summary	This environmental engineering unit introduces students to the important concepts of pollution and ecosystems. Students will learn about the interconnectedness of various parts of an ecosystem and the impact that humans can have on these systems. The students will work in groups to design a way to clean up an oil spill after learning about the various methods used to reduce human impact on the environment.
Content Area/Grade Level	STEM Grade 3
Unit Rationale	Environmental science is one of the most important fields of science today. The effects humans have had on the environment are tangible, and it is important for students to learn about the effects we are causing and the ways through which these effects can be reversed. This unit discusses one type of pollution – oil spills – and ways in which they can be cleaned up. Students will be able to make connections between the concepts learned throughout this unit and their own experiences hearing about major oil spills that have been in the news in recent years.
Resources	Unit based on Engineering is Elementary unit titled “A Slick Solution: Cleaning an Oil Spill” by the National Center for Technological Literacy at the Museum of Science, Boston

Learning Targets	
Standards Addressed	**2014 New Jersey Core Curriculum Content Standards - Technology** ● STANDARD 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. ● Nature of Technology o 8.2.5.A.2 - Investigate and present factors that influence the development and function of a product and a system o 8.2.5.A.3 - Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria and constraints ● Design o 8.2.5.C.1 - Collaborate with peers to illustrate components of a designed system o 8.2.5.C.2 - Explain how specifications and limitations can be used to direct a product's developments o 8.2.5.C.3 - Research how design modifications have led to new products.

	8.2.5.C.4 - Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models. 8.2.5.C.7 - Work with peers to redesign an existing product for a different purpose **Next Generation Science Standards** - Standard: 3 Interdependent Relationships in Ecosystems 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change - LS2.C: Ecosystem Dynamics, Functioning, and Resilience - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. - Standard: 3-5 Engineering Design 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 or prototype that can be improved. The performance expectations above were developed using the following elements from
Essential Questions	- How are the connections between organisms within an environment affected by pollution? - What kinds of connections exist between living and non-living parts of an ecosystem?

	● What impacts are humans having on the environment, and how do environmental engineers work to rectify these impacts?
Objectives	Students will know and be able to… ● Discuss the work of environmental engineers and their role in cleaning up pollution ● Describe some parts of an ecosystem ● Explain how one change in a n ecosystem may be related to other changes ● Explain how the Engineering Design Process can be used to help solve problems in the environment ● Explain how changes in soil and water pH can affect the health of an ecosystem ● Compare historical soil and water data to current data to build a case for the sources of pollution in a fictional town ● Discuss connectedness within an ecosystem, particularly the connections between soil and water and the spread of pollution ● Act as environmental engineers to present the findings of their pollution study ● Use a model to identify and explain how different parts of a given ecosystem might be affected by an oil spill ● Explain how a model of connections between living and non-living things in an ecosystem is useful, but also limited in representing the possible effects of an oil spill ● Conduct controlled experiments to evaluate materials, methods, and tools available for containing and cleaning an oil spill ● Design a tool and/or process for cleaning up an oil spill

Evidence of Learning	
Formative Assessments	● Change in Ecosystems worksheets – students draw conclusions about how and why an ecosystem changes over the course of fifty years using evidence about populations of species ● Class discussion during food web activity, during which students infer how pollution can affect an ecosystem based on the connections between living and nonliving parts of the ecosystem and food web ● Greentown Pollution activity – students use data about pH to draw conclusions about pollution in a fictional location
Summative Assessment	Oil Spill Cleanup Project: Groups of students take on the role of environmental engineer in order to design a process for cleaning up a model oil spill. Students use the engineering design process to ask questions about why the oil spill can be harmful to the environment and plan a solution for the oil spill with the intention of reducing the impact on the living and non-living parts of the ecosystem and environment.

Student Work Sample:

ASK

1. What is the problem that you are trying to solve?

To take all the oil out of the pond.

2. What are your **criteria** (the things you must do to be successful)?

You have to clean the oil as much as possible, remove the oil from the pond, and keep the oil from spreading.

3. What are your **constraints** (the things you cannot do, or the things that limit you)?

You can not spend more the $20.

4. Using the data from the materials experiments, list materials that work well to contain oil. How do you know that these materials work well?

The yarn and the rubber band are tied at 2. So I think both.

5. Using the data from the materials experiments, list materials that work well to remove oil. How do you know that these materials work well?

Nylon and the spoon because we tested all of them and Nylon and the spoon worked the best.

6. Explain why it is important to clean up an oil spill quickly and to stop it from spreading. (Think about the ecosystem, the food chain, etc.)

Because the fish will be covered in oil and they might die and if they die then the birds and the bears will not have enough food.

IMAGINE

1. Create a list of ALL of the materials you think you should use for your oil spill clean-up process. Next to each item, say whether it will be used to contain or remove oil.

Material	Contain or Remove?
Nylon	Remove
Spoon	Remove
Felt	Remove
Yarn	Contain
Rubber band	Contain

2. On your own, think of two **different** ideas for how to combine materials to clean up an oil spill. Next to each step, write whether the step is to

contain or remove the oil. (See the “Instructions page for an example of how to do this)

Idea 1		
Step:	What are you going to do at this step?	Contain or Remove?
1	Put a rubber band around the oil	Contain
2	Use a spoon to clean up the oil	Remove
3	Take the pipette to take any of the oil that is left	Remove
4		
5		

Idea 2		
Step:	What are you going to do at this step?	Contain or Remove?
1	Put yarn around the oil	Contain
2	Take nylon to scoop up the oil	Remove
3	If anything is left then take a spoon to scoop it up	Remove
4		
5		

PLAN

1. With your group, compare your designs from the Imagine step. List what was similar or different between your design and your group's designs. For example, if everyone in the group used a rubber band to contain the oil, you would write "Rubber Band" in the similar column.

Similar	Different
Rubber band Spoon Pipette	

2. With your group, create a list of steps that your are going to follow in order to clean up the oil spill.

Oil Spill Cleanup Plan		
Step:	What are you going to do at this step?	Contain or Remove?
1	First get the yarn to wrap around the oil	Contain
2	Then get the nylon and scoop up the rest of the oil	Remove
3	If their is any oil left then take two spoons and scoop it up	Remove
4		
5		

3. With your group, make a list of ALL of the materials you are going to use for your cleanup process. Then, find the total cost of all of the materials you would like to use.

Material	Cost per Unit	How Many?	Cost
Yarn (12 inch piece)	$1	1	$1
Rubber Band	$1		
Paper Filter	$1		
Cotton Ball	$2		
Small Sponge	$2		
Nylon	$3	1	$3
Felt	$3		
Pipette	$1 per squeeze		
Spoon	$1 per scoop	2	$2
		Total Cost	$6

CREATE

Follow your plan to clean up your oil spill. Then, answer the questions.

1. Did you have any problems while following your plan? What were they, and how did you solve them?

Yes. Because when we did our first scoop with the spoon we only got water. The second try we got so much oil.

2. Did you make any changes to your plan? What were the changes, and why did you make them?

No.

3. Use the table below to figure out your Total Score for your oil spill cleanup process.

COST SCORE Use the chart on the Instructions page to determine your Cost score.	2
SHORE SCORE Use the indicator paper to determine if the oil spread to the shore of your model river.	0
ECOSYSTEM IMPACT SCORE Use the Oil Indicator tool to determine how much oil is remaining in the water, and how far the oil spread.	10
TOTAL SCORE: Add the three scores above	12

3. How well do you think your process protected the environment? How do you know?

Yes. Maybe some of the animals can drink the water because it was a little clean.

IMPROVE

1. What parts of your oil spill cleanup process worked well? How do you know they worked well?

The shore score works well because it got 0. So the oil spill didn’t spread and it didn’t get on the shore.

2. What parts of your oil spill cleanup process **DID NOT** work well? How do you know they did not work?.

Te part that didn't really work well was the materials we had to buy 2 more materials

3. List at least one way you can change your process to improve your **cost score.**
(How can you make your process cost less, without changing how well it worked)?

We could have thought it through and checked it twice to make sure the materials were the best materials to use.

4. List at least one way you can change your process to improve your **shore score.**
(How can you make sure the oil spreads less?)

We can’t change our shore score because it was 0 so that was the best that we can do and that's the best score.

5. List at least one way you can change your process to improve your **ecosystem impact score.**
(How can you remove more of the oil?)

Maybe try to get a little little tiny bit more materials to try to clean up a little better.

	1	2	3	4	5
Ask	The student did not complete the Ask step, or gave insufficiently complete answers to most of the questions.	The student gave partial answers to some of the questions in the Ask step. The student's work does not indicate an understanding of how the scientific content relates to the design challenge.	The student gave answers to most of the questions in the Ask step. The student's work indicates a partial understanding of how the scientific content relates to the design challenge.	The student gave full answers to each question in the Ask step. The student's work indicates a sufficient understanding of how the scientific content relates to the design challenge.	The student gave full, thoughtful answers to each question in the Ask step. The student's work indicates a complete understanding of how an oil spill can cause harm to an ecosystem, and how environmental engineers apply properties of materials to help solve problems in the environment.
Imagine & Plan	The student did not complete the Imagine and/or Plan step, or gave insufficiently complete answers to most of the questions.	The student's (or group's) work ideas in these steps indicates a limited understanding of these steps of the design process. The students diagrams/plans may be incomplete or missing and do not reflect understanding of the constraints or criteria of the design challenge.	The student's (or group's) ideas in the Imagine and Plan steps indicate a partial understanding of these steps of the process. The students diagrams/plans are incomplete and may not reflect understanding of the criteria and constraints of the design challenge.	The student's (or group's) ideas in the Imagine and Plan steps indicate an understanding of these steps of the design process. The students' diagrams/plans in Plan and Imagine are complete and show understanding of the criteria and constraints of the design challenge.	The student's (or group's) ideas in the Imagine and Plan steps indicate an understanding of these steps of the design process. The link between the imagine and plan step is clear. The students' diagrams/plans are complete and show thoughtful consideration criteria and constraints of the design challenge.
Create & Improve	The student did not complete the Create and/or Improve step, or gave insufficiently complete answers to most of the questions.	The student gave mostly complete answers to some of the questions in the Create and Improve step. The student did not give answers for how the group's design can be improved.	The student gave mostly complete answers to most of the questions in the Create and Improve step. The student gave some consideration to how the group's design can be improved.	The student gave full answers to all of the questions in the Create and Improve step. The student indicated how problems were solved. The student gave limited consideration to how the group's design can be improved.	The student gave full and complete answers to all of the questions in the steps. The student indicated which problems they faced and how they solved these problems. The student gave thoughtful consideration to how his or her group's design can be improved.

Oil Spill Cleanup Process	The group was unable to complete a successful oil spill cleanup process; the students' work does not indicate an understanding of the concepts of environmental engineering learned throughout the unit.	The group was unable to complete a successful oil spill cleanup and did not identify how the process was not successful. The group's work shows a partial understanding of the environmental engineering concepts learned.	The group was unable to create a successful oil spill cleanup and was unable to identify why the design did not work. The design indicates a mostly complete understanding of concepts of environmental engineering.	The group was able to create a functioning oil spill cleanup, OR was able to identify the shortcomings of the design and plan for improvements. The design indicates a mostly complete understanding of the concepts of environmental engineering.	The group was able to create a successful oil spill cleanup, OR was able to identify the shortcomings of the design and plan for improvements. The design indicates a full understanding of the concepts regarding environmental engineering learned throughout the unit..
Group Work	The student did not participate in the project and did none of the work in the group.	The group struggled to work together. The student completed very little of the work for the group.	The student did not work efficiently with all group members. The student may not have done his or her share of the work in the group.	The student and their group worked collaboratively. The student completed a fair amount of work but may not have taken initiative to actively work with peers.	The student and their group worked collaboratively to solve problems and share ideas. The student completed his or her fair share of the work.

Student Name: (deleted)
Total Score: 23/25