Living Systems Field Trip Curriculum: Food Webs and Energy Transfer

Grade Levels: Middle School, High School

2016 Massachusetts Science and Technology/Engineering Standards Achieved:
Grade 7: LS2. Ecosystems: Interactions, Energy, and Dynamics
Grade 8: LS1. From Molecules to Organisms: Structures and Processes
High School: LS2. Ecosystems: Interactions, Energy, and Dynamics

Topics covered: Trophic levels, biomass and the building blocks of organisms, nutrient and energy flow, decomposers, herbivores, carnivores, autotrophs, pollution, food web dynamics and perturbations

About the Living Systems Laboratory

The Blackstone River Corridor Living Systems Laboratory (LSL) is a nonprofit organization that seeks to engage people in the socioecological history of the Blackstone River and create effective solutions to environmental contamination. The purpose of the LSL is to connect people with the River, help them to appreciate the benefits of a healthy ecosystem on society in the context of development, and be a part of the restoration of the Blackstone through education, research, and community outreach. The LSL especially hopes to engage students by offering them an experiential leaning opportunity to engage with the past, present and future of the Blackstone River. A healthy and prosperous ecosystem is defined by certain biomass, energy and nutrient flows. The LSL offers students an opportunity to better understand these flows and how natural cycles can be perturbed by breaking down food webs by function while demonstrating the restorative power of natural processes.

During the trip, students will experience an engineered ecosystem in which various strands of the food web are showcased and their function explained. The Eco Machine effectively shows the role of fungi, bacteria and plants in the recycling and of nutrients and energy transfer, allowing student to visualize how these elements are stored and transferred. Students will consider the methods of energy transfer and see firsthand how the different components of an ecosystem contribute to healthy ecosystem function, and how humans can foster healthy ecosystem development in order to promote public health.

After the trip, students will have a better understanding of the role of different organisms in the healthy functioning of ecosystems, and how healthy ecosystems benefit humanity. They will visualize the way nitrogen and carbon flow through ecosystems, and make up organisms. Students will be able to understand how energy is transferred through these ecosystems and begin to consider the role that humans play and potential solutions in the maintenance of ecological balance.

Background

The Blackstone River, birthplace of the American Industrial Revolution, is also assumed to be one of the largest sources of nutrient and pathogen pollution in the watershed. The long history of development along the river has left a legacy of antiquated infrastructure and development practices that continue to discharge nutrient laden stormwater and pathogens as well as inadequately treated sewage into the river and ultimately the Narragansett Bay. This area of the canal and river has been further degraded by oil and other toxins from the area's industrial past.

The Eco Machine and Canal Restorers were built in 2012 by John Todd Ecological Design, LLC in Grafton, MA, on the banks of the Blackstone Canal. They utilize the theories of ecological design and induced biodiversity to harness the abilities of native plants, animals, fungi and bacteria and other microorganisms to metabolize waterborne contaminants. By creating engineered microenvironments that induce biodiversity and amplify surface area, a diverse ecosystem of organisms metabolize nutrients and contaminants at higher rates than the compromised ecology of the canal and river.

Basic Principles of Food Webs.

Students will get the most out of a trip to the LSL if they have had exposure to the tenants of the subject of Food Webs and Energy Transfer prior to the excursion. Topics that they should be familiar with include:

What is an Ecosystem?

Food Chains and Food Webs

Producers, Consumers, Predators, Prey
Decomposers

Energy Sources and Transfer

Photosynthesis
Cellular Respiration
Transfer and loss among producers, primary, secondary, and tertiary consumers, and decomposers.

The Nitrogen and Carbon Cycle

The role of fungi, bacteria, plants
How humans alter the N and C cycle

Navigating the Learning Landscape. Now that students have a background in the tenants of food webs, they can use the Blackstone River and Eco Machine as an example of how biodiversity can be threatened, the risks to humanity, and to see how degraded ecosystems can be repaired. The questions below are a tool for teachers and are meant to guide the learning of students before and during their tour of the LSL.

Before the Tour

The Ecology of the Blackstone River

Where will you most likely find a producer in the natural ecosystem? What characteristics does it have and on what resources does it rely?

What trophic levels can be seen around the River, Pond and Canal?
Where do nutrients enter the ecosystem?
What part do humans play in this ecosystem?

Energy at the Fisherville Mill

What forms of energy can be seen at the site?
What forms of are humans using, and how is it returning to the ecosystem?

During the Tour

Nutrients and Energy in the Blackstone Canal

Why are the nutrients that humans add to the ecosystem good for some organisms by bad for others?

How are petroleum hydrocarbons affecting the Food Web? What does it mean for humans?

The Eco Machine

Where is photosynthesis occurring in the system? Cellular Respiration? Decomposition?
What do petroleum hydrocarbons resemble? Why are they not toxic to the fungi in the Eco Machine?

What happens to the energy during decomposition?
What is the fate of the nitrogen in the Eco Machine? Of the hydrocarbons?
How would a disruption to one of these microcosms affect the system as a whole?

After the Tour/Reflection

The Role of different Ecological Groups

What groups are the most important in a food web?
What would happen if the producers were removed? The consumers? The decomposers?

The Role of the Abiotic Environment

How are the organisms outside the Eco Machine different from the ones inside of it, even though some are the same species?

Disruptions and Human Activity

What would happen to the river's ecosystem if there were a disruption such as a hurricane? A flood? A wildfire? An oil spill?

How can humans disrupt a food web?
What do humans stand to lose if a food web is disrupted?
What other things can humans do to protect ecosystems and food webs?

Resources on Food Webs and Energy:

Annenberg Learner: https://www.learner.org/courses/envsci/unit/text.php?unit=4&secNum=3
Study.com: http://study.com/academy/lesson/cycles-of-matter-the-nitrogen-cycle-and-the-carbon-cycle.html

Resources on the Blackstone River:

Map of the Blackstone Watershed: http://www.thebrwa.org/map.htm
River History: http://www.nps.gov/blac/index.htm

Be sure to check out our guide *"LSL Field Trip Prep"*

Help us make the experience better for you!

We always look to improve. Let us know how we can help you achieve your teaching goals on this trip. Email us with any questions or concerns at livingsystemsintern@gmail.com.

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