



NSF GK12 Fellows' Traveling Road Shows 2009-10

Infusion of Scientific Research and Literature through Inquiry-Based Learning

Below are inquiry based learning activities for you to choose from that represent different topic areas within the Global Environment course. Please complete the Teacher Request Form on Page 2 to schedule road show visits to your classroom.

ECOLOGY (p.3)

Forest invertebrates and detritus-based food webs
The birds around us
Lakes as seasonally-changing environments
Anatomy of an ecosystem engineer
Riparian ecology: The streamside connection
Mosses, water relations, and habitat preferences

BIOGEOCHEMISTRY (p.5)

This is your watershed
The air you breathe
CO₂ variations over time

SUSTAINABILITY (p.6)

Plastics vs. biodegradable plastics: A student investigation
Yearly bedroom power consumption: An introduction into electricity
The biofuel debate
To cap and trade or to tax carbon emission, that is the question
CO₂ debate on how to regulate
Stormwater management: A collective responsibility
Plants and the watershed: Green infrastructure for your school
Forests full of fuel
Peat: A sustainable alternative energy source for New York State?
The ins and outs of China
Climate change: The science behind the headlines

RESEARCH AND ETHICS (p.10)

Hypothesis testing and regression analysis: Predicting real life?
Designing a sampling methodology for a research project
Can you put a price on nature?
What can statistics tell us about the class?

NSF GK12 Fellows' Traveling Road Shows Teacher Request Form

Please complete and submit this form 2-3 weeks prior to the desired date.

Fax: (315) 470-6890, Email thmajanen@esf.edu

Mail: ESF Outreach, 221 Marshall Hall, 1 Forestry Drive, Syracuse, NY 13210

School name _____

Teacher name _____

Time class meets _____

Days of week(s) class meets _____

Number of students _____

Teacher email _____

School phone # _____ Home phone # _____

Please list your choices for road shows:

1. Road show title _____ Dates _____

2. Road show title _____ Dates _____

3. Road show title _____ Dates _____

Additional comments/information:

Thank you for your request!

ECOLOGY

Forest Invertebrates and Detritus-Based Food Webs

Content Area: Ecology

In some ecosystems, such as temperate forests, the decomposition of detritus is of large enough scale to support a vast community of decomposers and consumers. This lesson stresses this concept to the students as well as introduces them to the local invertebrate fauna that depend on the breakdown of detritus. Students will travel to a nearby woodlot to search for local invertebrates then return to the classroom, break into small groups, and construct a food web describing that of the local community.

Time Requirement: 80 minutes recommended (40 min is possible if class is unable to go outside and search for invertebrates)

Materials: Small woodlot on or very near campus, computer and projector for introductory PowerPoint, posterboard for construction of local food web

The Birds Around Us

Content Area: Ecology

This road show introduces students to the diversity of birds in central New York. One (shorter) version presents birds and bird sounds, arranged by habitat. Students learn common birds as well as less familiar ones. Another version teaches students bird sounds, then gives them an opportunity to exercise their audio skills in a rousing round of “Bird Song Jeopardy.” Bird ID by sound as well as sight is a useful tool for bird population studies, so these skills could also be applied to field research projects. Finally, students are introduced to the NYS Breeding Bird Atlas, a tremendous resource for information on what birds live where in New York.

Time Requirement: One or two 40 minute periods, depending on the version used

Materials: Computer, projector, speakers and sound capability

Lakes as Seasonally-Changing Environments

Content Area: Ecology

Temperate lakes are a prominent and beautiful feature of our local landscape. They are important for a range of ecosystem processes as well as housing an important component of our local diversity. The organisms that live in lakes and make them work as a functioning ecosystem are adapted to persist in a constantly-changing environment. As the seasons change, so do the environmental conditions in lake water, often drastically. Students will observe a demonstration of water density and break into small groups to answer questions on how the changing lake environment affects organisms. A brief class discussion at the end of the lesson will summarize the important concepts of this lesson.

Time Requirement: 40 minute period

Materials: Computer and projector for PowerPoint presentation, microwave, small (~5L) aquarium and food coloring provided by instructor

Anatomy of an Ecosystem Engineer

Content Area: Ecology

In this lesson students will be introduced to the concept of ecosystem engineering. They will be given examples of different ecosystem engineers and how they affect their environment. Students will then have the opportunity to closely examine *Sphagnum* moss, a very important ecosystem engineer. They will make hypotheses about which of the morphological characteristics that they observed are involved in the ecosystem engineering. As part of observation, students will be asked to diagram the moss. As an optional exercise students will set-up an experiment to test how different species of *Sphagnum* from different environments affect their ecosystems differently.

Time Requirement: 60-80 minutes

Materials: *Sphagnum* samples, microscopes and/or hand lenses, paper and pencil/pen, computer and projector (optional - presentation could be done without projector), and for optional exercise - plastic cups and litmus paper (or pH meter)

Riparian Ecology: The Streamside Connection

Content Areas: Riparian zone, habitat assessment, water quality

This exercise introduces students to the riparian zone and its importance for water quality and habitat along streams. Outdoors, during habitat assessment exercise along the riparian zone, students learn to recognize major riparian trees and collect data on tree species and diameter. There is an option for students to read a brief (3 page) scientific paper about the importance of riparian zones in sustaining biodiversity; a question sheet accompanies the paper. The lesson can also be done entirely indoors using images of streams and samples of plant material brought in from outdoors or from a greenhouse.

Time Requirement: Two or three 40 or 50 minute class periods

Materials: Optional paper and question sheet

Mosses, Water Relations, and Habitat Preferences

Content Area: Ecology

Why do plants need water? How and where do they get the water that they need? Can the where and how of a plant's interaction with water be used to predict the kinds of habitats you would expect to find it? Plants, even more so than animals, are dependent on their habitats for meeting their water needs. This lesson will examine mosses, a group of plants that live in the tiny space between the land and the atmosphere, to look at different water gathering strategies and use this information to predict the kinds of habitats that plants with each strategy might be found. Students will learn that plants acquire water in different ways and their adaptations for water acquisition greatly influence the habitat in which they can live and thrive.

Time Requirement: 80 minutes

Materials: A variety of mosses from various habitats, a small fan, habitat lists and photos, paper towels, a balance, container for water

BIOGEOCHEMISTRY

This is Your Watershed

Content Areas: Water cycle, watersheds, topographic maps

This lesson introduces students to the watershed concept and its relevance to systems thinking. The global water cycle, with its various compartments and processes, provides the context for studying local catchments. Students begin by reconstructing the global water cycle as a class and learning terms such as infiltration, runoff, and groundwater. They then learn about selected local streams, such as where they begin and end, as well as impacts to streams and wetlands in the watershed. Using a topographic map they trace the “shedding” of water in their local landscape by following contour lines. An outdoor activity, where students observe stream and watershed conditions by visiting a nearby stream, is optional.

Time Requirement: One 80 minute class period or two 40 or 50 minute class periods

Materials: Computer and projector, overhead projector

The Air You Breathe

Content Area: Pollution

This lessons looks at common air pollutants, their sources and potential impacts. It highlights both local pollution and national trends. The activity introduces students to the Air Quality index, and includes mapping some of the worst and best places in the nation for particulate and ozone pollution. By the second semester this lesson should be able to be modified to look at local air quality.

Time Requirement: 80 min; modified 40 min if part of activity assigned as homework

Materials: Computer and projector, handouts, and 4 different colored pens for each group

CO₂ Variations over Time

Content Areas: Carbon dioxide, Excel

This lesson introduces students to the sources and sinks of carbon dioxide as well as how it fluctuates over time. After a brief introduction, the bulk of the lesson focuses on getting to know how to use Excel, and then interpreting the results. Data on CO₂ levels will be given from a variety of time scales ranging from hourly data collected recently to reconstructed data reaching back hundreds of millions years ago. The focus is get students using Excel to graph data.

Time Requirement: 80 min or two 40 min classes

Materials: Computer and projector, computers for the kids (at most two students to a computer), handouts on Excel. Datasets will be distributed to students.

SUSTAINABILITY

Plastics vs. Biodegradable Plastics: A Student Investigation

Content Areas: Sustainability, plastics, polymers, scientific method, experimental design

This lesson refreshes the students on the scientific method by having them design experiments studying differences between synthetic plastics and biodegradable plastics. After hearing lecture with information about plastics/polymers and biodegradable plastics, students will have to develop a plan to study the differences between the two. They will decide what question to ask and what conclusions they may find. Students will conduct an experiment in which they evaluate different plastics (used in their everyday life) and also weight plastics and place them in soil for about a week. After that week students will find and discuss their results.

Time Requirement: Two 40 or 80 minute classes (about a week or two apart)

Materials: Plastics, soil, jars (first three provided by Fellow), PowerPoint, balance, water, calculators

Yearly Bedroom Power Consumption: An Introduction into Electricity

Content Area: Sustainability, energy usage/calculations/reduction, electricity

This lesson tries to tie in the topics of energy and the students' lives together. Students will be introduced to the concept of electricity and how to calculate it. They will consider the sources of electricity and where electricity in Syracuse comes from. Students will assess the yearly power consumption of their own bedroom, compare it to class and national average and develop an action plan to reduce this consumption. They also obtain an understanding about electronic devices and their power consumption.

Time Requirement: One 40 or 80 minute class

Materials: PowerPoint, projector, calculators, handouts

The Biofuel Debate

Content Areas: Sustainability, resource management, energy, biofuels

With the rising concern of global warming and depleting petroleum reserves, alternative fuel sources are at a high demand. Solar, wind, and hydrogen technologies dominate the discussion where as biofuels operate under the shadow corn ethanol. This activity highlights many of the existing and future biofuel technologies. Students will learn the different types and then will be asked to find the pros and cons of each. The class will then be divided into teams and asked to defend a particular biofuel technology in a debate format with their classmates.

Time Requirement: 80 minutes

Materials: Computer and projector

To Cap and Trade or to Tax Carbon Emission, That is the Question

Content Areas: Environmental economics, environmental policy

One of the major policy debates among environmentalists, economists, and policy makers is how to create policy that will successfully reduce carbon emissions of firms. Much current debate centers on the costs and benefits in levying a carbon emissions tax versus creating a government run cap and trade pollution permit market. In this lesson students will be given a brief review of the economic tools used in each policy and a chance to apply those tools in a discussion. Each student or group of students will be assigned a firm, represented by information on an index card, and asked to discuss what decisions their firms would make given different market scenarios. After the simulation students will be asked to address the pros and cons of each situation given the actions their firms had to take and what they think the US government should consider imposing.

Time Requirement: Flexible

Materials: Projector for Power Point, black or white board, markers

CO₂ Debate on How to Regulate

Content Areas: Climate change, policy

In this activity, students will learn about the two main strategies to reduce CO₂ emissions discussed by policy makers around the world: cap and trade and carbon tax. Before the class, students will be asked to read a few background documents introducing both options and arguments from both sides of the debate. In class, students will be given a document containing more facts on each system and possible arguments against each. Divided into two groups, the students will then participate in a mock debate discussing these two options. Time permitting; an option would be to have students perform internet searches to support their 'side' before the debate. Afterwards, the class as a whole will discuss current applications of these two options and the difficulty associated with policymaking around science.

Time Requirement: 80 minute class (or 2 classes if students are to do independent background research)

Materials: Readings and handouts will be provided before and during class

Stormwater Management: A Collective Responsibility

Content Areas: Stormwater pollution, best management practices

Stormwater runoff is an inconspicuous contributor to pollution that has led to the degradation of nearby bodies of water. Urbanization has increased impervious surface area, which has increased the likelihood for stormwater pollution. Mitigating stormwater pollution starts at the local level, the everyday individual. The purpose of this road show is to introduce the concept of stormwater runoff and identify the various sources of stormwater pollution. Students are asked to develop a stormwater management plan using Best Management Practices while explaining how the individual in as much as the community has a role in addressing stormwater pollution.

Time Requirement: 80 min

Materials: Computer and projector, calculators, handouts, index cards

Plants and the Watershed: Green Infrastructure for Your School

Content Area: Watersheds

Entire civilizations have collapsed due, in part, to deforestation of watersheds, resulting in widespread desertification as well as siltation and even salinization of water supplies. This road show introduces students to the role of plants watershed health, and the current movement to replace or supplement “grey” infrastructure (rocks, concrete) with plant-based solutions. Students construct systems diagrams of watersheds (urbanized and not), learn about pathways of rainfall through forest canopy, and finally design a rain garden for their school using native plants.

Time Requirement: One 40 minute period to introduce the concepts, another period to design the garden

Materials: For indoor activity, chalk/white board, paper and pencils, calculator. If outdoor activity is incorporated, you’ll also need a line level, string, and stakes to measure slope, small shovel or trowel to collect soil sample.

Forests Full of Fuel

Content Areas: Sustainability, biofuels

A lot has been discussed in the media about the use of wood and other plant materials as potential carbon sources to produce ethanol. This activity takes an in depth look into the world of woody biomass fuel sources. Students will learn about the process of turning wood into fuel, and the required technology and infrastructure it would take to implement ethanol technology in the near future. There is then an indoor and or an outdoor activity where students will be asked to measure resources and calculate the ethanol yield based on available resources and their new found knowledge of the technology.

Time requirement: 80 minutes

Materials: Small stand of trees, measuring tapes, computer (with Excel) and projector

Peat: A Sustainable Alternative Energy Source for New York State?

Content Areas: Sustainability, ecology

In this lesson students will learn about the impacts that agriculture has on our environment. The students will be given a chance to share their own preconceptions and hopefully to change any of their misconceptions about agriculture. As an activity, the students, either individually or in groups will be asked to design a hypothetical “best” agricultural landscape and then to test their concepts against each other using scoring criteria for different scenarios that are given to them.

Time Requirement: 40-80 minutes (activity can be given in class or as a take-home assignment pre- or post-lecture)

Materials: Computer and projector, Design-A-Farm activity packet

The Ins and Outs of China

Content Areas: Sustainability, resource management, economics, foreign policy

Odds are a high percentage of the objects sitting around you are exported goods from China. This activity investigates the industrial characteristics of the world's most populous nation. Students will learn about China's role in the global economy, as well as the most recent figures on its potential impact in the coming years. These values will be compared to similar characteristics of the United States. The class will then be divided in half with each half representing a different Chinese industry. Each team is to create solutions to China's extreme growth and negative environmental impacts. Both teams will present their plans and debate as representatives of each nation.

Time Requirement: 80 minutes

Materials: Computer and projector

Climate Change: The Science behind the Headlines

Content Areas: Global heat engine, policy

Global warming is making news headlines everyday around the world. Students will be given an overview of the science behind global warming, including the top ten things that everyone should know about global warming. We will examine the recent findings of the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report. We will also discuss some of the scenarios for future greenhouse gas emissions and temperature increases. Students will explore the impacts of global warming, with an emphasis on the northeast region. This lesson is very flexible and can be adapted to suit the interests of you and your students.

Time Requirement: 80 minutes or longer

Materials: Computer with PowerPoint and projector

RESEARCH AND ETHICS

Hypothesis Testing and Regression Analysis: Predicting Real Life?

Content Area: Research data analysis

Statistical analysis is a necessary component to most research today. Rather than clarifying how the results were obtained, the regular use of computers creates a disconnect between entering data and obtaining the results. The purpose of this road show is to introduce students to statistical applications through activity-based demonstrations. Activity-based demonstrations allows to students to discover statistical concepts by active participation (Scheaffer 1996). Students learn the basics of hypothesis testing using a case study in gender discrimination and the basics of regression analysis using soil and air conditions. The hypothesis testing activity demonstrates statistical inference through practical simulation with playing cards. By the end of this lesson, students could apply their understanding to research projects and appreciate the value of statistics.

Time Requirement: 80 minutes

Materials: Computer and projector, handout, calculators, 5 decks of playing cards

Designing a Sampling Methodology for a Research Project: Case Study of Indian Butterflies

Content Areas: Project design, sampling, methods, butterflies

In this lesson activity, students will stay in the classroom and be split into groups (~4 students). Each group will be “contracted” and tasked with creating a methodology for a butterfly research project in India which they will present in front of the class. Students will be introduced to these methodologies through pre-assigned reading of scientific literature and through a short lecture/discussion. Ideally, students should have some background and understanding of the scientific method. The lesson will build upon this background to develop an understanding of sampling and experimental design. Throughout the lesson, students will be exposed to photos (of butterflies and more) from abroad and introduced to general butterfly identification techniques.

Time Requirement: 80 minutes; or two 40-minute periods

Materials: Computer and projector for PowerPoint presentation and photos; the following can be provided via email: scientific method handout, required reading (methods sections from scientific papers), and handouts for lesson activities.

Can You Put a Price on Nature?

Content Areas: Environmental policy, environmental economics

Environmental policy can be difficult to formulate and enact due to the variation in how the public values nature. In this lesson students will be introduced to the idea of environmental valuation and why/how it is used in policy making. After a brief introduction to the idea of environmental benefits as non-rival and non-excludable goods, students will be asked to put a dollar value on different components of the environment. After this exercise, the students will discuss the different values they placed on nature. The students will then be asked why/how they think this is important and what the implications the variances in values might have for environmental policies.

Time Requirement: Flexible

Materials: Projector for PowerPoint, black or white board, markers

What Can Statistics Tell Us About the Class?

Content Areas: Statistics, t-test, regression, cluster analysis

In this lesson students will practice collecting data and see how statistics can be used to interpret information about their class. On the first day, students will collect data (e.g. height, arm length, pet ownership, etc.) and compile a class data sheet. If available, students should practice entering this data digitally into Excel. All the data collected will be compiled into a class data sheet. On day two, after manipulation of the data by the lesson instructor (through a t-test, regression, cluster analysis, and more) the results will be presented to the class during a discussion of the reasoning behind some of the tests and the generated relationships. This will be followed by a discussion of how these tests apply to other situations (i.e. research projects).

NOTE: Students will NOT be taught how to perform these tests nor will there be a discussion of the mathematics behind each of the procedures. Instead, this lesson should serve as an introduction to what can be done with statistics.

Time Requirement: Two 40 minute sessions

Materials: Computer and projector for PowerPoint presentation, tape measure/ ruler; the following can be provided via email: data collection sheet, handout (summarizing each test used); optional: computers with Excel for students to enter data