

Life Under Your Feet Teacher Pages: Field Research on Box Turtles

This lesson plan introduces students to the concept of field research to study the relationship between organisms and their environment, and about how **macrosopes** can allow scientists to take continuous automatic measurements of a study area. The lesson plan gives students access to data from an ecology research study, and they use the data to study environments on various spatial scales and time scales.

Overview

Concepts

- Scientists often work by monitoring field research sites
- One of the drawbacks to field research sites is that scientists must return to them again and again, which can damage the environment being studied
- One possible solution to this problem is a *macroscope* – a network of “notes” – sensors connected to a computer – that automatically record data for long periods of time
- Data from macrosopes can be accessed online
- A key element in determining the environment of a place is its *ground cover* – what type of vegetation is lying along the ground. Ground cover can help regulate the temperature and moisture of an ecosystem.
- The *local environment* can vary widely within the same study area, and understanding this local environment is important for understanding the ecosystem.
- Ground cover can impact where turtles lay their eggs, or where they spend the winter.
- Soil temperature changes in a daily and seasonal cycle
- Variations in soil temperature are smaller at greater depths because there is more soil to insulate the soil from large changes in temperature
- Similarly, variations in soil temperature are smaller for forest cover than for grass cover because the trees act as insulators, keeping the soil warmer in the winter and cooler in the summer.

Target Audience

- Middle school earth science or biology
- High school earth science or biology
- High school environmental science
- College introductory environmental science, earth science, or biology

Goals

By the end of this project, students will be able to:

- Use a web tool to view data and make simple graphs
- Identify and explain cyclical changes in soil temperature
- Describe the relationship between a specific organism (Eastern Box Turtles) and specific characteristics of that organism's environment (ground cover in Jug Bay Wetlands Sanctuary)

Prerequisites

Before starting this project, students should:

- Understand the meanings of the terms *organism*, *environment*, and *ecosystem*
- Recognize characteristics of the environment – for example, rivers or ground cover – from a remote sensing image of the Earth
- Comfortably use web-based tools to retrieve data and make graphs
- Feel comfortable sketching a graph and appropriately labeling its axes

Vocabulary

- **Field research site** – an area where scientists go to get a better idea of how the natural world works. They may make observations of organisms, take measurements of characteristics of the environment, or conduct experiments in the field
- **Macroscope** – a network of sensors, connected by wireless links, that allows scientists to automatically and regularly measure data from a field research site

Real World Relevance

The relationship between organisms and their environment is a key understanding for students to understand what ecosystems are. Understanding ecosystems is important for citizens to make informed decisions on environmental policy, so exposing students to these concepts could help develop this knowledge early.

In addition, the project exposes students to using online tools to retrieve data and make graphs. Using online tools to retrieve data is a key technology skill in the modern workplace, and making graphs is an important mathematical skill.

Worksheet and Sample Solutions

The student project can function as a worksheet for students to record their answers, either electronically or as a printout.

For sample solutions to the project, E-mail Jordan Raddick at raddick@jhu.edu .

Background Resources

See the [About Soil Ecology](#) Section of the Life Under Your Feet learning site for more information about the science of soil ecology.

See the [About Macroscopes](#) video on YouTube for more information about what Macroscopes are. Wireless sensor networks are another name for Macroscopes.

There is more technical information about our macroscopes in [About Sensors](#).

Our research group was profiled in a [Nature news article](#) in March 2006; that article contains more information about our macroscopes.

For more information about Box Turtles, see the following links:

- [Presentation about Box Turtles at the American Geophysical Union meeting in Fall 2007](#)
- [Blog post about Eastern Box Turtles](#)

Science Standards Met by this Project

NSES Content Standards

5-8

Science as Inquiry – Abilities – 3: Use appropriate tools and techniques to gather, analyze, and interpret data. *Students use web-based tools to retrieve data and make simple graphs.*

Science as Inquiry – Understandings – 3: Mathematics is important in all aspects of scientific inquiry. *Students create simple graphs to represent changes in data over time.*

Science as Inquiry – Understandings – 4: Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations. *Students use measurements taken by a macroscope – a device that measures temperature and soil moisture accurately and automatically over a period of months.*

Science and Technology – Understandings – 3: Science and technology are reciprocal. *Students learn that microscopes are a new piece of technology that are used to conduct scientific research. The design of microscopes are driven by scientific needs, and as microscopes improve, new scientific projects are enabled.*

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Science as Inquiry – Abilities – 3: Use technology and mathematics to improve investigations and communications. *Students use web-based tools to retrieve data and make simple graphs.*

Science as Inquiry – Understandings – 3: Scientists rely on technology to enhance the gathering and manipulation of data. *Students use data collected through a microscope project – a new technology – to answer scientific questions.*

Science as Inquiry – Understandings – 4: Mathematics is essential in scientific inquiry. *Students create simple graphs to represent changes in data over time.*

Life Science – The Behavior of Organisms – 2: Organisms have behavioral responses to internal changes and external stimuli. *Students learn that the nesting behavior of turtles is influenced by changes in the soil temperature.*