Skill Building: How to Perform Longitudinal Studies of the Environment

A longitudinal study is any type of investigation in which data is collected for a long period of time. This type of study is often used to learn about trends and patterns that only emerge from repeated observations of the same parameters. Most environmental studies are longitudinal, because the many dynamic factors that affect natural communities can be best measured over extended periods.

A longitudinal study can be of any length, for example:

- Following stream flow below, during, and after a rain
- Measuring light penetration on a forest floor during the day or throughout the year
- Doing transect/quadrant studies to determine levels of invasive plants over many years.

Because many teachers and students have limited access to field trips, they often believe that longitudinal studies are impossible. But with some creativity and organization, longitudinal studies can easily be done with your students.

Teachers usually do the same activities with their students each year, or several times during the school day. The hard part is organizing the procedures for the collection of the data so the results are reliable and valid. Teachers must also develop a method of data storage so that the data can be archived for future uses.

Option I: Long Term Student Studies

It's rare that students get the opportunity to revisit a site again and again, but extremely valuable. When asked to choose a topic for independent research, students often opt for whiz-bang short term studies. But simple measurements repeated over time often provide far more significant results.

It's always important to develop a set of protocols that can be accurately repeated. When a protocol is developed for a longitudinal study, think about:

- Using the same equipment each time the experiment is done
- Making sure the equipment is reliable
- Making sure that students know how to use the equipment
- Practicing data collection for reliability
- Establishing the location where data will be collected (map skills)
- Establishing the time of day and/or date of collection
- Establishing the units and degree of accuracy of the measurements.

The same area, same item, same time of day, and same time of year are all variables that must be maintained in order to reliably develop patterns and trends that can emerge from the data.

Option II: Sharing the Responsibility

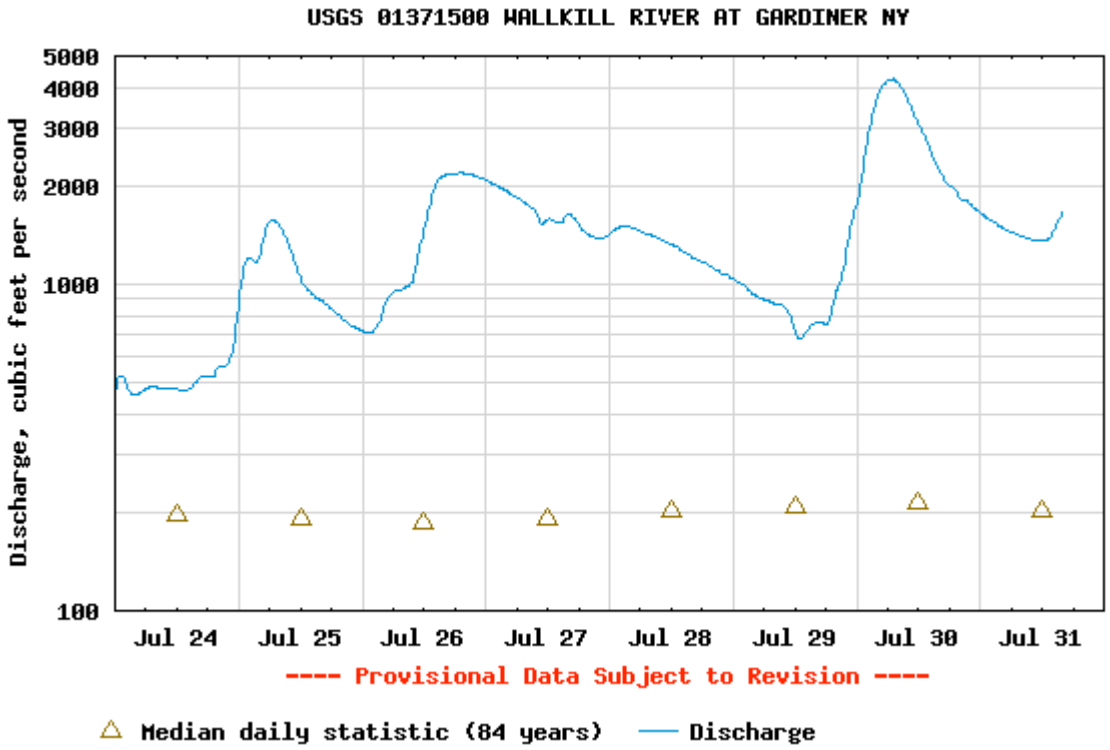
When the standardization described above is carefully developed, an experiment can be continued by a new set of students each new school year. Students may know that each experiment must have a "procedure." But they will need special preparation for a procedure they will share with others. When students share the responsibility, it's extra important to emphasize the protocols.

Data Storage
When collecting the data, create a way to store the data in a format that can be easily added to with each new data set. This can be as simple as a paper/pencil spreadsheet or as intensive as Excel or ArcGIS type computer program. Inclusion of date, location, student names/numbers is also critical. These data become very important when trying to correlate between data sets. Make sure that all data is appropriately labeled with the correct units of measurements. Software and hardware can change from year to year, so it's important to store the data in several different formats. (A visual format that students can share and anticipate encourages enthusiasm for a project that may last longer than some of your students have lived!)

Here's an example of a longitudinal study done at an elementary school in Wisconsin. Students wanted to follow changes in the occurrence of purple loosestrife in marshy fields, and determine what natural controls might work to control them. They carefully mapped three areas of similar topography, and developed a technique for taking quadrant counts of loosestrife each fall and spring. Then they implemented two procedures for controlling the population. Each year, third graders were responsible for counting the loosestrife. Charts were maintained from year to year, and students discussed the changes as they progressed through the grades. The project became a permanent part of the school community.

Reach for a Star
There are times when it's appropriate for students to use longitudinal data from another source, such as a satellite or ground receiver, and to validate that data with as few as one on site "ground truthing" observation. That makes the satellite or other remote data more meaningful. It's also possible for many students or researchers to share the responsibility of ground truthing the remote data, using online tools for that cooperative research.

Here's an example of remote, longitudinal data obtained for the Brandwein Nature Learning Preserve watershed collected by USGS:



This data can be accessed directly from USGS http://waterdata.usgs.gov/nwis/rt
Students might follow the stream flow data for weeks or months prior to visiting the creek, comparing it to rainfall data and predicting changes in stream flow before and after a heavy rain.

Read More

National Water Information System http://waterdata.usgs.gov/nwis/rt

How GPS Works: http://www.nasm.si.edu/gps/work.html

Map Tools including finding stream flow stations: http://nationalatlas.gov