Stream Biodiversity and Function

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Focus: The students will analyze indicators of stream health from across the United States by plotting data and performing descriptive statistics and linear regression.

Overview: This lesson centers around analyzing the correlation between different indicators of stream health. The students will complete a lesson in R to practice creating scatter plots and preforming linear regression. Additionally, students will practice summarizing data, calculating outliers, and creating boxplots. They will apply the methods from prior lessons in the final lesson of the course to analyze stream data from Region 4, which contains Atlanta, more independently.

Learning objectives:

1. Perform descriptive statistics and linear regression in R
2. Create boxplots and scatter plots of stream health data from different EPA regions.
3. Practice coding elements necessary to do basic R calculation operations and perform useful functions: summary(), abline(), lm(), quantile()
4. Compare, contrast, and summarize patterns of stream health locally and nationally

Lesson sequence:

1. Prelab reading of in-class worksheet (Prepare before and use during lab)
2. Wet lab portion measuring stream health indicators at Proctor Creek
3. Swirl lesson
    a. Introduction
    b. Descriptive_Statistics
    c. Linear_Regression
    d. Region_4

Pre-lesson activities: Students will complete a prelab reading on pollution, stream health, and chemical and biological indicators of stream health. An additional reading introducing the EPA dataset will help students understand the data they will be analyzing in the Swirl Lesson.

Post-lesson activities: Students will complete a synthesis activity where they make a statement about the health of streams in the United States using the data and peer-reviewed sources. The goal is to have them practice synthesizing and drawing conclusions from data.

Implementation notes: This course was designed to be done in a 3-hr laboratory period where students independently complete the four lessons. This course can be used in conjunction with a lab where students travel to a local creek and sample nutrient levels and macroinvertebrate levels in the field. The course is subdivided into four lessons to facilitate students stopping and starting as they review how R works. It includes descriptions of the functions and operators they will be using, so it provides a gentle introduction to plots and linear regression in R. Encourage students to save their scripts and paste code and any notes as they go so they can generate their own R code to continue examining the data for the synthesis activity.

Helpful References for Background:

Stoddard, J.L., A.T. Herlihy, D.V. Peck, R.M. Hughes, T.R. Whittier, E. Tarquinio. 2008. A process for creating multimetric indices for large-scale aquatic surveys. Journal of the North American Benthological Society *27:* 878-891.

Klemm, D.J., K.A. Blocksom, F.A. Fulk, A.T. Herlihy, R.M. Hughes, P.R. Kaufmann, D.V. Peck, J.L. Stoddard, W.T. Theony, M.B. Griffith. 2003. Development and evaluation of a macroinvertebrate biotic integrity index (MBII) for regionally assessing Mid-Atlantic highland stress. Environmental Management. 31:656-669.

U.S. Environmental Protection Agency. 2001. Ambient water quality criteria recommendations: information supporting the development of state and tribal nutrient criteria. (http://water.epa.gov/scitech/swguidance/waterquality/standards/criteria/aqlife/pollutants/nutrient/rivers_index.cfm). Accessed April 17, 2010.

U.S. Environmental Protection Agency. 2009. Invertebrates as indicators. (http://www.epa.gov/bioiweb1/html/invertebrate.html) Accessed June 2010.