Diurnal and Seasonal Variations of Water Quality at TSU Wetland

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A. Overview Information

TITLE: Diurnal and Seasonal Variations of Water Quality at TSU Wetland

ABSTRACT: This lab/course project is designed to test and improve students data processing ability. The data set is one-year (2016) water quality parameters collected using YSI 6820 V2 Multi-parameter Water Quality Sonde. Data collected include pH, temperature, dissolved oxygen (O2), conductivity, and turbidity. Students will learn how to process data and show diurnal and seasonal variations of these water quality parameters. This laboratory module can be tailored for both non-majors and majors in Biology, and is a hands-on, problem-based, group-learning project that draws upon multiple disciplines (e.g., Biology, Chemistry, English, Math).

KEYWORD DESCRIPTORS

- **Ecological Topic Keywords:** dissolved oxygen, temperature, pH, conductivity, turbidity, water quality, ecosystem health, diurnal variation, seasonal variation
- **Science Methodological Skills Keywords:** data organization, statistical analysis, graphing data, literature searches, scientific writing
- **Pedagogical Methods Keywords:** problem-based learning, cooperative learning, hands-on learning

CLASS TIME: This project is designed either as a 3-hr lab session, or as a course project.

OUTSIDE OF CLASS TIME: Students will spend about 10 hours analyzing data, composing a rough draft, editing their draft, and producing a final lab write-up.

STUDENT PRODUCTS: Lab report (3-5 pages)

SETTING: This experiment is geared toward any aquatic ecosystem.

COURSE CONTEXT: This project can be tailored for both non-majors and majors in Biology, in addition to being utilized in Environmental Science, Chemistry, Microbiology, and Ecology courses.

INSTITUTION: Four –year, public, university, or two-year, public, community college

TRANSFERABILITY: This lab requires a data set of one-year measurements of water quality using YSI sonde. The data set is made available online at the NSF TIP project website. Computer with Excel is need for data processing.

B. Synopsis of Lab Module

Principal Ecological Question Addressed: How did water quality parameters vary within a day and from season to season? What factors drove these diurnal and seasonal changes?

What Happens: Before class, students need to read the basic function of YSI 6820 V2 multi-parameter water quality sonde and understand the structure of downloaded data. Students also need to be able to use Excel to process data. Students can be separated into small groups and they can learn with each other on the Excel use. Their final product will be to write a scientific paper, and present their findings as either a PowerPoint presentation or a poster presentation.

Learning Objectives: At the end of this lab exercise students will be able to:

1. Understand the importance of water quality
2. Understand why these key water quality parameters need to be measured
3. Learn the use of Excel, and how to process data in Excel
4. Analyze data and show diurnal and seasonal variations of these water quality parameters
5. Construct a scientific paper in the format of a primary research article
6. Present primary research data via a poster and/or oral PowerPoint presentation

Equipment/ Logistics Required:

- Data set of dissolved O_2, pH, temperature, conductivity, and turbidity
- Computer with Excel

Summary of What is Due:

- Organized data sheets with descriptive statistics
- Statistical analyses
- Scientific write-up (written as a primary research article)
- Either a poster presentation or a 15-minute PowerPoint presentation

C. Description of the Lab Activity

Introduction

Water quality refers to the chemical, physical, biological, and radiological characteristics of water. Water quality is measured by several factors, such as the concentration of dissolved oxygen, bacteria levels, the amount of salt (or salinity), or the amount of material suspended in the water (turbidity). In some bodies of water, the concentration of microscopic algae and quantities of pesticides, herbicides, heavy metals, and other contaminants may also be measured to determine water quality.

Poor water quality can pose a health risk for people. Poor water quality can also pose a health risk for ecosystems. At TSU wetland, good water quality is essential to not only a healthy ecosystem, but also to human health, as the water is eventually flowed into Cumberland river, a drinking water source for Nashville. Wetlands play a vital role in filtering runoff water before returning back to the river and environment. Wetland environments also provide a niche to countless species of bacteria, invertebrates, and vertebrates; and are critical in the energy purveyance to bordering habitats by way of water and nutrient cycles.

Some aspects of water quality can be determined right in the stream, at the well, or at the wetland. These include temperature, acidity (pH), dissolved oxygen, and electrical conductance (an indirect indicator of dissolved minerals in the water). Analyses of individual chemicals can be done at a laboratory. With the advantage of new automatic sensors, water quality can be monitored and recorded automatically using some instruments.

The YSI 6820 V2-2 is a cost-effective data sonde for profiling and spot-checking water quality in rivers, lakes, wetlands, wells, estuaries, and coastal waters. It is a multi-parameter, water quality measurement, and data collection system. It can be used to measure temperature, conductivity, pH, dissolved oxygen, turbidity. Other sensors such as nutrient, chlorophyll content can also be added and measured.

Data are automatically recorded at set time period (e.g., every 15 min) and stored in the storage memory. A laptop computer is required to download data into computer. One year data (2016) have been downloaded and can be used for this lab session.

Materials and Methods

Study Site:
TSU wetland. Data of water quality have been collected for more than one year, at three places at TSU wetland.

Overview of Data Collection and Analysis Methods

Lab Activity: Collecting Water Samples from YSI Sonde and Conducting Data Analysis

Purpose:
Students will learn proper techniques for data collecting from the YSI sondes, and organizing water samples for later use in the laboratory. Students will use statistical software such as Excel to analyze collected data and draw general conclusions. Their findings will then be written up in the format of a scientific paper and presented as an oral or poster presentation.

Materials:
Computer with statistical software package (*e.g.*, Excel, SPSS).

Homework:

References

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Tools for Assessment of Student Learning Outcomes:

Assessment
Students will be assessed on three different aspects: statistical analyses, written scientific write-up, and presentation of data.

The statistical analyses will be used to assess the student's quantitative ability, and their ability to draw valid conclusions from a data set. The scientific write-up and presentation of data will be used to assess the student's ability to communicate orally and through written word.

D. Comments to Faculty Users

E. Appendix

One year water quality measurement data