**UNH Living Bridge – Water Quality Curriculum**

This curriculum is designed for high school students studying water quality. In particular, the content of this curriculum pertains to the Piscataqua River and the Living Bridge Project through the University of New Hampshire. This document includes several lessons which can be used individually or as a comprehensive unit.

**The Living Bridge Project** (https://livingbridge.unh.edu/)

The Living Bridge Project at the University of New Hampshire is an NSF-funded project that aims to develop a self-diagnosing, self-reporting “smart bridge” that is powered by renewable tidal energy. The bridge is outfitted with webcams, sensors, and a turbine platform that generate data and allow scientists to develop new technologies. The sensors on the bridge report information on stress levels, traffic, and weather that can have various impacts on the bridge’s construction. The turbine platform is attached to the southern bridge pier and includes a tidal turbine as well as water quality sensors. The Piscataqua River has a lot of marine traffic as well as strong outgoing tides, which makes it a unique spot to place this platform. Studying this project will give students the opportunity to analyze real-world water quality data and explore new and emerging technologies. For more information about the project, see <http://smartbuildings.unh.edu/the-living-bridge-project/>.

* Before students start exploring the Living Bridge, introduce it by showing them the following video:

<https://livingbridge.unh.edu/?p=551>

There is also an article associated with this video (it is posted above) that students can read as well. Have students discuss in pairs:

1. the importance of the Living Bridge
2. what kinds of data they think will come from it
3. how do they think this data will compare to other areas of the watershed

**The Living Bridge Water Quality Assessment**

Previously in the class you have learned about the water cycle in New Hampshire, the Great Bay Watershed, and local New Hampshire seacoast land use. There are a lot of factors that affect water quality within a watershed and it often has to do with how humans change the land.

**PART 1 – Mapping the Memorial Bridge and Piscataqua River**

1. Using the internet, find a map of the Piscataqua River including the Memorial Bridge. You will be drawing your own map of this river using the criteria below. You may use any up to date map as long as you can include all of the components listed.

* You must label the Memorial Bridge
* You need to include a half of a mile of the Piscataqua on either side of the Memorial Bridge
* You must have a scale
* You need to label AT LEAST 10 businesses/parks/research facilities/marinas/personal homes along the one mile stretch of the Piscataqua
* You need to label AT LEAST 5 sources of pollution runoff including what type of pollution (i.e. nitrates, dirt debris, etc.)
* It must be colored

1. You will be using your map later on for data analysis so keep it in a safe place.

**PART 2 – Analyzing Data from the Living Bridge**

1. Go to <https://livingbridge.unh.edu/>
2. Click on Research Login on the top right
3. Click on Access Estuary Data (this is public access data!)
4. Create a table that includes the following parameters:

* Temperature (in Celsius!)
* Salinity
* Dissolved Oxygen
* pH
* Turbidity
* Nitrate
* Phosphate
* TWO ADDITIONAL PARAMETERS OF YOUR CHOICE

1. Choose TWO, 2-week time frames during two different part of the year (for example: July 1-July 21 and December 1-December 21). REMEMBER: THESE DATES HAVE TO BE ONES THAT HAVE ALREADY HAPPENED
2. In your lab notebook, create a hypothesis for what you think your parameters will indicate during the two different times of year. Write a short paragraph below of why you think you will see this (Hint: Look at the maps of the Piscataqua River and the Great Bay watershed!!)
3. In the Living Bridge database, download your data parameters for the two timeframes you have selected. You will have to put the dates in! REMEMBER: THESE DATES HAVE TO BE ONES THAT HAVE ALREADY HAPPENED. Fill in your chart with the data that you download. If there is no data for a certain day, leave it blank. You may also want to create an AVERAGE column for your data to calculate an average for your parameters in your two-week time frame.
4. Complete the following questions in your lab notebook for the data that you just collected from the online database:
5. Was your hypothesis supported or rejected? How did you come to this conclusion?
6. Which time of year is more Eutrophic in the Piscataqua River? Why do you think this is?
7. In your data table, there is a certain measurement that can be used to calculate what is called conductivity. Using your resources, find an equation that you can use to convert one of your measurements to conductivity. Use the equation to solve for conductivity. BE SURE TO USE CORRECT UNITS. What does conductivity tell you about the water quality?
8. What does turbidity tell you about the watershed around the river? What other measurements (parameters) in your data table tell you the same thing?
9. In a clean, healthy river, would you expect to see high or low oxygen levels? Which of your times of year are you seeing a higher oxygen level? Why do think this is?

**PART 3 – Comparing “The Living Bridge” Data to the Overall Great Bay Watershed**

1. Take out your Great Bay Watershed map and your Piscataqua River map.
2. Go to the National Estuarine Research Reserve System (<http://cdmo.baruch.sc.edu/get/landing.cfm>). Scroll down and click on the Real Time Data Application.
3. Find the THREE New Hampshire water quality data sites from the Great Bay Watershed. For each one:
4. Mark the location of the data buoy on your Great Bay Watershed Map
5. Create a table for each location’s data for two different SPECIFIC dates that correspond closely with the dates that you chose for the Piscataqua River data.

**PART 4 – Writing the Final Paper**

For your final analysis paper, you will be comparing the data from the Piscataqua River sensors on the Living Bridge with the three Great Bay Watershed data buoys.

* Your paper should be typed, double-spaced, 12-point Times New Roman
* You should have a cover page that includes your name, date, class section, and title
* Your written paper should be AT LEAST two pages long

The body of your paper should include:

**Introduction:** You should use the information that you have collected throughout this unit to discuss water cycle, the important of water quality, and the significance of watersheds. You should also discuss the Great Bay Watershed in particular and how the Living Bridge is crucial in the maintenance of this watershed.

**Three Body Paragraphs:** Each body paragraph should discuss the Piscataqua River data from the Living Bridge sensors and compare it to each of the other Great Bay watershed data buoys (hence the 3 paragraphs). Compare the data from these different locations within the watershed and discuss the reasons for the differences during same parts of the year. YOU SHOULD BE USING SPECIFIC DATA FROM YOUR CHARTS AND THE INFORMATION THAT YOU HAVE GATHERED ABOUT THE WATERSHED TO SUPPORT YOUR STATEMENTS.

**Graph:** Using your data tables, graph your data using Excel. You have free range over the graph that you create but it MUST corroborate with your body paragraphs and conclusion in this paper.

**Conclusion:** Wrap up your paper with final conclusions and any interesting things that you may have seen in the data that you did not mention above in your body paragraphs.