ESSENTIAL QUESTION: What invasive species are affecting our watershed?

Introductory Lesson #1

To start this unit, I am going to try to immediately establish (or uncover maybe a better word) a personal student connection to lite area. Ask students to name their favorite local place to visit/enjoy and WHY they feel this way. Following this, I will ask students to describe (using words and drawings) the habitat of their ''place", listing any species they know reside there or they have seen there. We will discuss our places in a scientist meeting (students sit in a circle and pass a "talking ball" around to share their places) and we will trace any commonalities. After we have thought about, written and drawn, and shared our places I will give the students a situation to think about. I will show them a case scenario where a type of invasive has overtaken an area (making it unusable). Students will list their initial thoughts and reactions, and we will discuss. I will then re-propose the scenario that such an invasion happened to their favorite place. Again, students will list/share their thoughts/feelings. To end the class I will ask three questions that will set-up the unit: I. Could there be an invasive(s) infestation occurring in our watershed? 2. How do invasive species affect the organisms and quality of our ''places"? 3. How can we survey for invasives and determine their presence or lack thereof?

Formative Lesson Ideas (#2-9)

2 Where is our local watershed? What is the quality of the watershed?-To begin our investigation, our class will discover our local watershed. Large laminated regional maps will be laid out on tables, and each lab group will try to determine the boundaries of the watershed using pre-taught mapping clues (mountains + valleys showed by contour lines, contour lines showing flow of rivers). Once students see the region that is consumed by the local watershed, students will analyze a pre-made map by labelling the major towns and water bodies of the watershed (using their own local knowledge supplemented by atlases). I hope this continues to instill a personal connection to this unit.

After giving a sense of perspective of the geography of the watershed, we will analyze the quality of the watershed. Our high school has been doing a study of a local river that is a major tributary of Lake Memphremagog since 1995 (with a few gaps in data due to external circumstances). Students will learn how the data is collected and what the water quality of the watershed is using the WQI. This index will provide a nice I word statement (the WQI is stated in terms of quality being "poor", "fair", "good", or "excellent"). **This will be our starting point**- what is the current (and past) quality of our watershed, and what species are residing in our waters? {Lesson 1-3) From there we will see what invasives are (lesson 4), which could be in this watershed (lesson 5) and how can we go see for ourselves what is happening (lesson 6-8).

3 Biotic/ A biotic factors of the watershed- Students research and explore the biotic factors (living organisms) in their local watershed. Our school has a number of contained samples of macro invertebrates, fish, and other species within Memphremagog. We also have numerous tanks that are filled with local species. Students will try to identify the influence of species on the ecosystem (this unit will be done after an ecology unit where ecosystems, food webs, and food chains are understood) Students will also look at abiotic factors in addition to the biotic factors of the watershed. Non-living factors are an essential topic to take into consideration, especially when discussing the movement/transport of invasives.

4 What are invasive species? Initial look at invasive species. What are they? What defines an organism as invasive? What are the benefits/drawbacks? What is difference between terrestrial and aquatic invasives?

5 What are some local invasive species that are threatening our wilderness? Once students have an initial understanding of what invasives are, they can begin to investigate what species threaten our region using databases, online research, and identification materials. Following this research, students will make a **Watch List-** a list of invasives to be on the look out for at our site visit. This watch list will help students focus on a shorter list of possible invasive species, rather than leaving the range open to any invasive worldwide.

6 What materials do we use to survey for invasive species? (Let's build them!) Students will build survey rakes for their group to use on the site visit. Materials will be provided and a sample product will be on display as students work with their group. In addition, students will choose ID keys and pamphlets that are helpful to them to identify species. Student groups will begin to organize their materials and prep for our site visit.

7 How do we survey using the rakes and what will we do on our site visit? Students *learn how to survey for aquatic invasive plants/species* using tools that we created. Class will go outside and practice "throwing the rake". Class will practice packaging and storing a sample to be brought back to the lab (classroom) for further study. Class discussion of safety procedures, behavior expectations, and logistics of our field trip. Final preparation of testing materials and ID keys.

8 Site visit and invasive testing. Upon arriving to site student groups will have multiple tasks to accomplish. 1. Listing of at least 5 native species using field guides/ID keys. 2. Sample for invasive/native aquatic species using sampling rakes. Inventory results. 3. Mark testing spots on map of site. 4. Collect any questionable samples to be taken back to classroom.

→ *In addition to data collection and surveying, I will use the field visit to assess a couple skills/concepts gained/practiced in class. I) I will pre-select 3 species at the site that students must identify using a provided field guide or dichotomous key. This will assess their ability to use the key as practiced. 2) I will choose a "sit-spot" for the students to gather at. While listening silently, I will have students' list 3 biotic factors and 3 abiotic factors that they can identify from that spot. This will assess their knowledge of these terms in a real world setting.*

*I would love to be able to do multiple site visits, potentially looking at one site with little amounts of invasive vs. one in which invasives seem to be more prevalent. This will all be time dependent. The more sampling and more data the better.

9 Post site visit analysis. Students will analyze collected samples and attempt to identify any questionable samples. Data collected at the site and in class will be entered into a provided spreadsheet of classroom data. This data will be organized in multiple formats (data tables, graphs, and comparative spreadsheets). Class discussions of what invasive species were discovered, what their impacts could be, and what can be done to limit their spread and influence.

To bring this unit back to where it all began, the class will get out the laminated maps with the watershed boundaries traced out. Students will mark on map where sampling occurred. Following this, I will give each lab group a set of analytical questions to go along with the map. These will be the first set of lab report questions. Examples of questions: I) If Eurasian water milfoil was found in Clyde Pond, where else could this plant invade just due to drainage of the basin? 2) What impacts could this have on the northern milfoil populations of Clyde Pond?

Lesson # 10 CULMINATING ACTIVITY: Summative Assessment to Essential Question

My thoughts on this activity have shifted many times since I first wrote this bird's eye view in August. .. I started with a few service pieces or citizen scientists ideas. Then I jumped over to the idea of a lab report. I wasn't satisfied with the lab report idea, as it seemed limiting and didn't give students to analyze their newfound knowledge, simply write about it and present it. Reflecting upon on all my ideas, I finally reached an idea that I am content with (for now). *My final event for this unit may be creating an "**Analytical Invasive Species Report",** completed by each group (or individually) as well as "**Community Invasive Report**" done as a class. The individual report will involve a question section that will present students with scenario based questions to apply their knowledge to. Lastly, the data collected by our class will be **entered into online databases of invasive species surveying.***

I like this idea for a few reasons. The students will be comfortable writing a lab report, so they will be using a familiar medium for presenting knowledge. Writing labs makes one reflect on the entire experience, not just the ending result and data. The new question section will give students a chance to truly "apply" their learning, not just present it. The community report will be a chance for the class to create a polished product that can be sent to local media outlets and newspaper for presenting to the community.

In the "Analytical Invasive Species Report" students will present:

- **Question:** Outline the question of our investigation.
- **Purpose:** Provide the purpose of the investigation
- **Summary of procedures:** What was done in the investigation? What tests were completed, and how?
- **Materials:** List of materials used in the investigation.
- **Data section:** Data tables showing the species sample, identified, and collected. Maps of area showing where surveying occurred.
- **Questions:** 2 sets of lab questions will be presented. These questions will analyze the knowledge that students have gained throughout the entire unit (content about species, sampling surveying practices/equipment, data analysis, critical thinking). Some questions will be based on content; some will be case scenarios that students will have to critically analyze. The 2 sets will be:
    - Question set for *map analysis* (factual and hypothetical questions about our watershed)
    - Question set for *analysis of invasives and data* (content questions and situation based questions where students critically analyze a scenario)
- **Discussion:** Overview of what species (native/non-native/invasive) were found in our study. Discussion also analyzes what the data collected shows us about an invasive presence in the Memphremagog.
- **Conclusion:** section where students relate back to the essential question of the investigation. Students must use evidence from the data and discussion sections to back up their conclusion statement.

The **"Community Invasive Report"** will be a whole-class report that details the events and findings of the unit. This will be a condensed version of a lab report, with more visuals of the experience and processes. The report will also focus on the data collected, and reporting the potential impacts of those species found.