ESSENTIAL QUESTION: How do humans impact the water quality of the Lamoille River?

Introductory Lesson #1

In what way will you introduce students to the big idea? Show fish kill pictures from Shelburne Pond.

Inquiry lesson: Where does our water come from? What happens to it in the Lamoille watershed and where does the water go? Pose the questions and then ask students how they would find the answers.

NGSS

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Enduring Understanding: Interdependence: Everything is made up of interconnected systems; a change in one system affects other systems.

Formative Lesson Ideas (#2-9)

List title of each lesson, brief discussion of learning plan and its outcome. What aspect of the big idea will students grasp during this lesson? In what way will you provide formative assessment and the opportunity to practice new knowledge and skills? How will they build their understanding of the essential question?

2 Sparkling Water (adapted from WET). STEM Students act as sewage treatment plants in a municipality. They have a budget and tools and have to clean dirty water. This activity is to give students a basic understanding of how water is cleaned by nature and by human intervention and that it is time consuming and difficult.

NGSS-STEM

Students who demonstrate understanding can:

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

3 Benthic Collection and I.D. At Test Site- What benthic macro invertebrates live in the Lamoille River, what are their tolerance levels to pollution and what does this mean about water quality?

4 Physical Assessment of Test Site- Nearby roads, erosion evidence, rail trail proximity, farming, stream bank assessment- how does any of this affect water quality?

5 Chemical Testing at Site- D.O. , change in temp., pH, nitrate, phosphate tests. What does this mean about

water quality? The data from each group in each class is analyzed to come up with the data from the four classes and then together we analyze that data and students rate the water quality based on this information.

6 Scientists Meeting- making sense of data. Do we need more data? Can we make preliminary conclusion? Remember the essential question. Using the histogram that we have made as whole grade students will rate thewater quality and then in the meeting share their findings and why they think the water is a certain quality. When looking at the data they can determine how many benthos we found in each group (intolerant to pollution, moderately intolerant to pollution, moderately tolerant to pollution and tolerant to pollution).
NGSS

MS-LS2-4.

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.

7 Visit waste water treatment plant- Where does the school water go and what happens to it before it gets there? How does phosphorus contribute to pollution and where does it come from? How is the water treated, why does it cost so much?

7a. Parent Interview- how does the family use the river, what do they think of the water quality now and what did they think of it as a younger person (provided they grew up in the area). This is to get the family talking aboutthe river and its role in the community of Morrisville.

7b. Clean Water Act of 1972- How the clean water act changed the way we treat water. The impact of the act specifically on Morrisville. The wastewater treatment plant was built in 1974 as a direct result of money from the act.

8 Ecology of Lamoille River- relationships between biotic and abiotic factors and how energy is transferred.
NGSS

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)
- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)

9 Rain garden and bio-retention areas surrounding one school parking lot. What a great opportunity for learning. Over the summer a rain garden and bio-retention area were place around a parking lot at school. The director of the conservation district of Lamoille County will come in to explain to students how they work and

why they are needed. This will tie in with visiting the wastewater treatment plant and the above mentioned sparkling water activity.

10

Lesson # 10 CULMINATING ACTIVITY: Summative Assessment to Essential Question

FINAL OUTCOME: **ESSENTIAL QUESTION:** How do humans impact the water quality of the Lamoille River?

What is the water quality of the Lamoille River? How do humans impact the water quality?

Part 1: Watershed Map of Lamoille River:

This map includes the major tributaries, headwaters, mouth, towns along the river. Students outline the watershed and draw in the towns etc. This aids students in figuring out where they are in the world and how the human population has dramatically changed the landscape.

Part 2: Mitigation of human impact on the Lamoille River:

Using data from the water quality tests and other activities students describe a way to mitigate human activity in and around the Lamoille River. They will include qualitative data and quantitative data as evidence. Human impact can include information from rain gardens the waste water treatment plant and other information from the·LCCD website.

Dream EVENTs: Canoe trip to the mouth of the Lamoille River next to Sand Bar State Park. It really does end at Lake Champlain; Mrs. Bronner was not making it all up! We would do this in the late spring to bring us fully from headwaters to mouth. I will show pictures of the headwaters back at step 3.

Service Learning: Student driven- but could be a report to Lamoille Anglers, the trout club, the community at large. They could get involved in town government; there are plans afoot to build condos along the river near oxbow park invasive species counting. Green-up day activity –picking up refuse along the rail trail that runs from the oxbow in town to our water testing site.

The following background work is not listed above but is essential for students overall understanding of water quality. This work will be done during the formative assessment 2 and 3.

A. Reviewing the water cycle.

B. Introducing and practicing river vocabulary; river system, tributaries, headwaters, mouth, observation, inference, quantitative observation, qualitative observation, inve1tebrates, metamorphosis, organic matter, benthic macroinvertebrates, delta, oxbow, biotic and abiotic.

C. Information on water quality testing, background.

D. Science Explorer, Earth's Waters (Prentice Hall): "How is Water Important? "Read pgs. 16-22.

E. Science Explorer, Earth's Waters (Prentice Hall): "Streams and Rivers" Read pgs. 42-52.

F. Science Explorer, Earth's Waters (Prentice Hall): "Water Underground" Read some of this section, starts on p.68.

G. Using the website: http://www.vtwaterquality.org/planning/htm/pl_lamoille.htm
This website is the LCCD and it has an incredible amount of information on the Lamoille River Basin.

H. Major water use chart . Students prioritize water use and then ask their families to do it also.