BUFFALO NIAGARA RIVERKEEPER®

# Enhanced River Academy Curriculum: Introductory Module, Part I

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## OVERVIEW

**Name of the Course**

The River Academy: Place-based Environmental Science Program

**Course Description:** Using a series of place-based, water-focused modules, the River Academy aims to empower a cohort of students to become active citizens in protecting and preserving local waterways. This intensive program includes 9 modules covering cultural, historical and environmental perspectives, hands-on field ecology trainings, water quality monitoring practicum, service learning workshops and paddling lessons.

**Name of the Module:** Introduction to the River Academy

**Module Description:** This module serves as the introductory module for the entire training program, and it will provide historical perspectives on the Buffalo-Niagara region, foundational knowledge of the Niagara River watershed (including Buffalo River), and substantial understanding of community-based environmental stewardship. It will also introduce students to upcoming modules, program expectations and field protocols.

**How to Use the Module:** The module is structured in a way that any teacher with no formal training in Watershed Science can pick it up, review the materials and launch it in the classroom. A teacher should digest the rationale of the module by reviewing the CONSCIENTIZATION section, and proceed with the LESSON PLAN. The instructions in the LESSON PLAN are detailed enough for use by teachers unfamiliar with the subject matter, and are supported by media presentations and hands-on exercises.

## CONSCIENTIZATION

### Audience and Context Analysis

*The Introduction to the River Academy* acquaints students with water-related environmental issues in the Buffalo-Niagara region and helps them to become immersed in community-based environmentalism. The target audience is middle and high school students – ages ranging from 12 to 19 years. Participating students are expected to have a minimum of middle school level natural and social science education or equivalent, basic computer literacy and some interest in the outdoors. The introductory module may be commenced in-class, outdoors or both.[1]

### Next Generation Science Standards Themes

- HS – Earth Systems
- HS – Weather and Climate
- HS – Human Sustainability
- HS – Interdependent Relationships in Ecosystems

**Common Core and STEM Initiatives:** Participants of this module will be exposed to the contextualized Mathematics and Geological Science practices that enhance their efficiencies in STEM subjects.

### Objectives for Significant Learning Experiences

After this module is over, participating students will:

1. Understand the core concept of a watershed, and remember key elements of Buffalo-Niagara region ecosystems (FOUNDATIONAL);
2. Decide to actively engage in upcoming modules (APPLICATION);

[1]Recommendation for launch site(s) can be found at respective Lesson Plan.

3. Relate the health of local waterways to the existence of organisms, well-being of communities and thriving blue economy (INTEGRATION);
4. Come to see themselves as defenders of the Niagara River watershed (including Buffalo River) and protectors of local waterways for generations to come, and encourage fellow students to get involved in fresh water resource preservation efforts (HUMAN DIMENSION);
5. Value fresh water, commit to protect drinkable, fishable, swimmable waters, and energize to become active stewards in Western New York (CARING); and
6. Relentlessly engage in environmental education, identify additional learning opportunities and strive to become resourceful environmentalists (LEARNING HOW-TO-LEARN).

**Topic Analysis**

1. Watershed as a System – Grand Introduction
    - The Great Lakes and You
    - Who is Niagara?
    - Holistic Concept of Watershed
2. Environmental and Cultural History of Buffalo-Niagara Watershed
    - Revisiting the Watershed Concept
    - Screening of *If Our Water Could Talk*
    - Problems and Issues
3. Our Water and Our Future
    - Usurpation of the Public Trust
    - Screening of *If Our Water Could Talk*
    - Rust to Blue
4. Program Overview and Expectations

- What Can I Do?
- Overview of the Modules
- Expectations and Field Safety

**Implementation Challenges**

Transportation and Logistics

**Length of the Module**

In-Class Activities: Approximately 3 – 4 Hours

Out-of-Class Activities: Approximately 6 – 8 Hours

**Program Materials and Equipment Needed**

***Instructor Qualifications:***

- Be community-oriented and well-versed in High School level Earth Sciences;
- Be highly motivated to mentor students to become young environmental stewards; and
- Be cognizant of pedagogical methods and applications.

***Materials and Equipment:***

- Intro to Watershed PowerPoint slides;
- A course Blog for reflective entries;
- *If Our Water Could Talk* WNED Documentary; and
- Appendixes (A. I and A. II).

**Recommended Room Setup**

The room can be set up at teacher's discretion as per class size and group dynamic. However, the classroom should have audio-visual screening capability.

**LESSON PLAN**

***Module Name:*** Introduction to the River Academy

***Lesson 1:*** Watershed as a System Grand Intro

***Timing:*** One Class Period (Approximately 35 to 40 Minutes)

***Learning Objectives Addressed:***

- Understand the core concept of watershed, and remember key elements of Buffalo-Niagara region ecosystems (FOUNDATIONAL);
- Relate the health of local waterways to the existence of organisms, well-being of communities and thriving blue economy (INTEGRATION);
- Relentlessly engage in environmental education, identify additional learning opportunities and strive to become resourceful environmentalists (LEARNING HOW-TO-LEARN).

**IN-CLASS PLAN**

| TIMING | SUB-TOPIC(S) | TEACHER NOTES & CUES |
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| 10 – 15 Minutes | Lakes and You | BACKGROUND<br>• The Great Lakes are the largest freshwater ecosystem in the world—90% of North America's freshwater supply. Due to past industrial history, many areas in the Great Lakes are environmentally degraded and are designated as "Areas of Concern" or "AOCs". Total of 43 AOCs have been identified—26 located in the United States, 12 in Canada, and 5 in shared boundaries.<br>ACTIVITY<br>• Teacher-led icebreaker<br>  ○ Teacher will share his/her personal environmental story related to lakes or water.<br>  ▪ HINT: Share teacher's experience with local waterway, and discuss how s/he became involved in environmental education. |

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| | | ○ Teacher will initiate critical thinking among students by invoking their personal experiences with lakes and/or local waterways.<br>○ Teacher will encourage students to immerse in the beauty of the Great Lakes, and compel them to examine their perspectives on water around them.<br>▪ SHOW: *Watershed as a System* Media Presentation Slides #2 through #4 (*apply embedded notes when appropriate).<br>▪ HINT: Challenge the students, and push them to critically examine what the Great Lakes and freshwater really mean to them. Use "the Bucket and the Spoon" demonstration when appropriate (See Appendix A. I).<br>ASK<br>• Can you name the Great Lakes?<br>○ How many Great Lakes have you visited?<br>• Which Lakes border Western New York?<br>○ Do you have any memorable experience with lakes or water in general? If so, please share with the class.<br>• When you see the satellite image of WNY among the lakes, how do you feel?<br>• Why are the Great Lakes so important to us?<br>○ What do they mean to you?<br>○ Do you think other countries have this kind of treasure in their backyards?<br>○ What percentage of the world's fresh water do |

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| | | you think is in the Great Lakes?<br>COMMENT<br>• One-fifth of the world's aboveground fresh water is located in the Great Lakes. We are very fortunate to have such natural wonders and vital resources in our own backyard.<br>ASSESSMENT<br>• Forward-Looking → Students will actively engage in discussion questions prompted by the teacher, and critically analyze the importance of local fresh water resources during the engagement.<br>• Feedback → Teacher will provide constructive and encouraging feedbacks to students' discussion response when appropriate. |
| 15 – 20 Minutes | Who Is Niagara? | BACKGROUND<br>• The Niagara is not technically a river, but a "connecting channel". The Niagara drains four Great Lakes, a watershed of ~ 263,700 square miles.<br>• Over a 37 mile run, the Niagara drops from 570 feet above sea level at Lake Erie to 247 feet above sea level at Lake Ontario. Niagara Falls is about half that drop (160 feet).<br>• The Niagara supplies 83% of the tributary flow to Lake Ontario. The average flow is 212,000 cubic feet per second (cfs). 50-75% of this flow is diverted for power generation.<br>• 91 species of fish and over 366 species of birds have been documented in the Niagara.<br>ACTIVITY<br>• Teacher-led factual presentation of the Niagara River |

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| | | ○ Teacher will share how the Niagara River was formed, and present geological and ecological features.<br>▪ SHOW: *Watershed as a System* Media Presentation Slides #5 through #6 (*apply embedded notes when appropriate).<br>▪ HINT: Integrate fun Mathematical exercises to enhance students' interest in the River (See Appendix A. II).<br>ASK<br>• How long is the Niagara River? Can anyone guess?<br>• Is the Niagara alive?<br>COMMENT<br>• The Niagara River is not just another "river" – it serves as one of the major north-south flyways for migratory birds and is recognized by the Audubon Society and a nationally significant Important Bird Area.<br>• It also produces much needed energy for residents living in the New York State and beyond.<br>ASSESSMENT<br>• Forward-Looking → Students should actively participate in calculating retention time and other fun exercises, and show enthusiasm to learn more about the Niagara River.<br>• Feedback → Teacher should engage with students in nurturing their mathematical skills and provide constructive feedbacks for their answers. |
| 10 – 15 Minutes | Holistic Concept of Watershed | BACKGROUND<br>• Groundwater contributes up to 45 % of the stream flow |

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| | | in the watershed.<br>• On average, about 8% of the watershed is impervious to water infiltration, ranging from 46% impervious for the Scajaquada Creek basin, to 4% for the Tonawanda Creek basin. 8% of the watershed is mapped as wetlands, with about half of that (4%) protected under NYS regulations. The Tonawanda Creek basin has the most wetlands (11%).<br>• About **30%** of the watershed (245,000 acres) is forested. The Buffalo River basin is 41% forested, mainly in the steeper sloped upland regions of its tributaries near the Portage Escarpment<br>ACTIVITY<br>• Big group discussion on the Niagara Watershed<br>o Teacher will share the concept of relationship between land and water, and encourage students to reflect on their bodies' water composition.<br>▪ SHOW: *Watershed as a System* Media Presentation Slides #7 through #8 (*apply embedded notes when appropriate).<br>▪ HINT: Teacher may compare the watershed to a body, and nurture students' ability to think holistically.<br>o Teacher and student will various explore ecosystem services that support the health of watershed.<br>▪ HINT: Once again, compare watershed ecosystem services with functions of body organs. Challenge students to inquire if a body can sustain itself |

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| | | without functioning organs.<br>• Introductory screening of WNED documentary *If Our Water Could Talk*<br>  o Students and teacher will watch the inspirational documentary video briefly as an intro to watershed<br>  ▪ SHOW: If Our Water Could Talk (00:00:00 through 00:05:30)<br>ASK<br>• What is a "river"? What is a "watershed"?<br>• How is a watershed similar to your body?<br>  o How do our activities on land affect the quality of the water in a river or creek channel?<br>  o What happens to the "system" of your body if organs are unhealthy? What happens to the Niagara River watershed if a sub-watershed is unhealthy?<br>  o What can we do to maintain functioning ecosystem services within the watershed?<br>  o What are the impacts of healthy or unhealthy watershed on you? On your community? On our animal neighbors?<br>  ▪ HINT: Highlight the importance of healthy watershed for prosperous economy and community enjoyment.<br>COMMENT<br>• A watershed is defined by a geographic boundary of high elevation. Like a sink basin, all of the water in the watershed drains downhill towards its outlet.<br>• We are water! Our bodies are primarily composed of water—so is the watershed. |

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| | | • Rivers and streams are not just water in the channel. Rivers run through the landscape—on the surface of the land as runoff, and below the ground as groundwater. All of the land inside the watershed boundary is connected by water.<br>• When we look at a watershed or a river, we need to look at it holistically—it is a system with many important and interconnected services and functions. Because of this connectedness, impacts in the watershed can trigger problems in other parts of the system.<br>• Ecosystem services are economically measurable benefits provided to us by a healthy watershed, and include filtration of pollutants from our water, flood water storage, fish and wildlife breeding, CO2 absorption from plant growth, recreational opportunities and water for drinking and industrial use.<br>• To keep our watershed healthy, we need citizen action. It is very important that we see a watershed as an entity, treat it with respect and help maintain its integrity and ecosystem services.<br>• In the end, if the watershed suffers, we all suffer. Our prosperity, health and community depend on this watershed.<br>ASSESSMENT<br>• Forward-Looking → Students and teacher will actively participate in nurturing discussions and analysis of the watershed as a system. Students should show enthusiasm and share their well-thought perspectives on the watershed.<br>• Feedback → Teacher will channel students to become |

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| | | active watershed stewards by providing constructive feedbacks and encouragement during discussions. |
| **OUT-OF-CLASS ACTIVITIES (HOMEWORK)** | | |
| **TIMING** | **SUB-TOPIC** | **TEACHER NOTES & CUES** |
| Varies | Visit Your Waterway | ACTIVITY<br>• Students' visit their nearest waterway or water body<br>  ○ Each student will visit a stream, river, wetland or lake, and spend some times to transcend daily obligations, contemplate how they are connected to the waterway, and appreciate the natural wonder.<br>COMMENT<br>• When you are at your waterway, think about how water has been a joyful part of your life, and fun water-related activities you could do in the future.<br>ASSESSMENT<br>• Forward-Looking → Students will visit the lakes and share some of the fun things they can do with water with the class. |

## APPENDIX

### Appendix A. I: The Bucket and the Spoon Demonstration

It is important to contextualize the importance of freshwater in the Great Lakes of North America. The Great Lakes retain approximately 20% of aboveground global freshwater resources.

***Demonstration Procedure:***

***Step 1 –***

Bring a 5-Gallon Bucket and a Teaspoon to the Class.

***Step 2 –***

Recruit 2 volunteers from the class and assign them to fill a 5-Gallon Bucket with fresh water from the tap, and ask them to place the Bucket in front of the class. Ask students to assume that the water inside the Bucket is the total water the Earth contains.

***Step 3 –***

Ask 1 student to come forward, and assign him/her a teaspoon. Then, ask that student to scoop out a spoonful of fresh water from the bucket. Ask students to assume that the water in the spoon represents all available aboveground fresh water on earth. The rest in the bucket CANNOT be consumed, because it is not the fresh water.

***Step 4 –***

Ask the student with the Spoon to spill 4/5 of the water in his/her on the floor. Ask students to assume that the reminder in the spoon is the freshwater OUR Great Lakes retain.

## Appendix A. II: Lake Retention Time

The retention time of a lake is a measure of how long an average body of water stays in a particular lake. It depends on the volume of the lake and the amount of water flowing in and out of the lake. Lake retention times are important for understanding the spread of pollutants, as well as conceptualizing the overall water cycle.

***How to Calculate the Lake Retention Time:***

1) Find the Volume of the Lake
2) Find the Mean Rate of Flow of the Lake
3) Divide the Total Volume by the Average Flow Rate of the Lake

***Resources for the Lake Retention Time Calculation:***

- US EPA Great Lakes Factsheet: http://www.epa.gov/greatlakes/factsheet.html
- US NOAA Lake Profiles: http://www.glerl.noaa.gov/pr/ourlakes/lakes.html