



Water LITERACY

WHITE PAPER

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Overview

Education is power. When it comes to understanding, managing and using our water resources, education becomes even more powerful. Humans and nature are intertwined. Since we rely on water resources for our very survival, grasping their value as well as the importance of responsible use is critical. That comprehension is at the heart of water literacy and Great Lakes literacy.

Great Lakes literacy is defined as an understanding of the Great Lakes' influence on people and our influence on the Great Lakes.¹ Applying that understanding by making responsible decisions about natural resources is also an essential component of water literacy. Water literacy is a fundamental component of Great Lakes-related education.

When talking about water literacy, we often start with the facts, and they are compelling: nearly 100 percent of North America's surface fresh water is in the Great Lakes, which have the second longest coastline and interface with coastal residents in the United States. However, as often as we mention these facts, the significance of the Great Lakes and our reliance upon them cannot simply be explained through numbers or statistics. A crucial piece of water literacy and natural resource stewardship is developing a personal connection with water resources.

All living organisms need water to survive; this concept is central to water literacy. As a result, water quality is one of the most important characteristics of a healthy ecosystem. Clean water supports a diversity of plants and wildlife. In turn, our actions on land affect the quality of our water.

Another important component of water literacy is recognizing that global and local water resources are finite. Fostering the seven-generation ecological concept by urging our current generation to live sustainably and work for the future benefit of the seventh generation may help promote the wise use of our water resources.²

Challenges

While the *Next Generation Science Standards* provide a framework for incorporating more content about earth science into the K-12 curriculum, limited content about the Great Lakes in the classroom has been a significant barrier to increasing awareness about water resources.³ Also, the absence of sustained support for teacher professional development presents ongoing challenges.

Although some educational leaders have migrated away from lecture-based teaching methods in favor of experiential learning through observation and interaction with the environment, applying this in the classroom is challenging. Educators are often pressured to focus on testing as opposed to delivering content in an innovative and engaging manner. However, there are models that demonstrate the benefits of new educational approaches. For example, New Tech high schools focus on project-based learning to support students collecting and analyzing data, making predictions, designing experiments and drawing conclusions.

Many organizations are making an incremental impact separately. A significant challenge to increasing water literacy is the absence of a common focus among state government, universities, non-government organizations, businesses and foundations. Researchers at Stanford University believe a common agenda is one of the keys to large-scale change.⁴ Collectively, we may be able to have a much greater impact if we can agree on common goals to improve quality of life, including life-long education.

¹ Great Lakes Literacy Principles, COSEE-Great Lakes, Great Lakes Sea Grant Network, 2010.

² The Constitution of the Iroquois Nations, The Great Binding Law, www.indigenouspeople.net/iroqcon.htm.

³ Next Generation Science Standards, www.nextgenscience.org.

⁴ Kania, J., Kramer, M., Collective Impact, Stanford Social Innovation Review, Winter 2011, Stanford University.

Water Literacy and Trends in Healthy Functioning Systems

It is impossible to separate an organism's need for water from the need for habitat and food. All living organisms depend on these basic necessities and are part of a complex web of life. Multiple sectors have adopted a more holistic view of human-induced impacts on water, land and air. For example, many faith-based organizations include education about the interdependent web of life and businesses and industries have stepped up efforts to adopt best practices to reduce the environmental impact of their activities.⁵

The complexity of the Great Lakes ecosystem makes it difficult to manage. However, an important trend in managing water and its dependent natural resources involves better coordination and cooperation. Adaptive management allows for greater flexibility to adapt to a changing environment, economy, policies, stakeholder needs and many other factors.⁶ New trends in natural resource management are connected to environmental stewardship, formal education and engagement with various stakeholder groups that have a vested interest in protecting water quality.

Nearly every watershed in Michigan is connected to the Great Lakes. Learning about these connections by taking a watershed approach is critical to understanding how we are connected to our friends and neighbors through this vast system of streams and rivers that drain to the Great Lakes. No point in Michigan is more than six miles from an inland lake or stream, or more than 85 miles from one of the Great Lakes.⁷ Thus, maps are powerful teaching tools for youth and adults and provide the opportunity to explore issues regarding physical properties, land use and water quality.

Educational leaders have made an effort to demonstrate how water literacy is an important part of the grade school curriculum. For instance, the K-4 science standards include grade-level content expectations that focus on life requirements, life cycles, water and water movement, as well as other topics. The content expectations span four science disciplines: science processes, physical science, life science and earth science.⁸ If students understand the relationships in a simple food chain, they better understand the importance and sensitivity of these connections, and why changes to one part of the food chain almost always impact another. This material prepares youth for more advanced challenges in high school and beyond, such as using real data to test a hypothesis, engage in inquiry and develop conclusions.

Another significant shift is effectively communicating the value of our resources by conveying the relationship between a healthy environment and a healthy economy to the public. A central theme of state government officials, the tourism industry and other organizations, this concept has in part resulted in significant funding from the federal government to restore habitat, improve water quality and remove contaminants.⁹

The Michigan Coastal Management Program has prioritized efforts to reduce the economic and environmental impacts of more frequent and severe storms on coastal wetlands, develop best practices for reducing erosion in critical dune areas, improve forecasting and public outreach about dangerous currents, and develop procedures, rules and guidance to classify areas for offshore wind energy.¹⁰ This plan includes specific actions to educate targeted groups, support additional research, work in partnership with businesses, community groups, local government leaders and non-government organizations and change state policies.

⁵ Michigan Clean Marina Program, www.michigancleanmarina.org.

⁶ Schroeder, B., Dann, S., Ariganello, S., *The Life of the Lakes*, p. 104-109, 2012, MICHU-12-501, Michigan Sea Grant.

⁷ *An Introduction to Michigan Watersheds*, 2012, MICHU-12-412, Michigan Sea Grant.

⁸ Science v.1.09, Grade Level Content Expectations, Michigan Department of Education, Office of School Improvement.

⁹ Great Lakes Restoration Initiative, greatlakesrestoration.us.

¹⁰ Section 309 Assessment and Five-Year Strategy for Coastal Zone Management Program Enhancement, Fiscal Years 2012-2016, Michigan Coastal Management Program, Office of the Great Lakes, Department of Environmental Quality.

Water Literacy and Trends in Human Use and Enjoyment

While Michigan offers a variety of wonderful natural resources, what truly sets our state apart is the presence of the Great Lakes: the inland seas that physically shape our geography as well figuratively shape our culture. The Great Lakes provide us with many things and subsequently, an economy and way of life that are highly linked to the Lakes. Understanding and respecting that connection is possible through water literacy. Use and enjoyment of the Lakes seems relatively simple, however, the ways we interact with the Lakes is rarely simple. Often when we are able to use the lake for economic benefit, there may be a tradeoff, making management and wise decision-making even more important.

Michigan citizens use our water resources in a variety of ways:

- **Drinking Water:** The Lakes provide drinking water to 40 million U.S. and Canadian citizens and provide 56 billion gallons of water per day for municipal, agricultural and industrial use.¹¹
- **Manufacturing and Agriculture:** Industrialization of the region in the early 20th century gave rise to a manufacturing industry that benefited from proximity to water for industrial processes and shipping, and is still the top source of employment in the region.¹² Such activity established great port cities, but also resulted in environmental impacts that are still being assessed and mitigated. Ready access to water for irrigation continues to support a strong agricultural presence.
- **Shipping:** There is a long history of shipping on the Great Lakes, beginning in 1825. Over 200 million tons of cargo is shipped across the Lakes annually, however, the industry has fallen on hard times due to water level changes and competition with other modes of transport.
- **Recreation and Tourism:** Waterfront communities and destination-worthy natural features ground the state's \$12.8 billion travel industry.¹³ Fishing, diving and boating are a few of many recreational activities.
- **Commercial and Sport Fisheries:** Commercial and sport fisheries contribute \$1 billion and \$4 billion respectively to the Great Lakes economy.¹⁴
- **Employment:** An analysis of economic data shows that more than 1.5 million jobs are directly connected to the Great Lakes, generating \$62 billion in wages in 2009; over a third of those jobs are based in Michigan.¹⁵

Beyond economic support, the Lakes offer us something more profound. As humans, we are drawn to the water. It speaks to us in a way that extends beyond simply how we can use it, sell it or make it work for us. The Great Lakes are integral to our well being. A trend referred to as placemaking is the practice of maximizing a community's natural resources and assets to create high quality of life. As recognition of this less tangible connection to the Lakes expands through initiatives like placemaking, water literacy is growing more fundamental to sustaining healthy communities.

Water literacy is important when considering human use and the Great Lakes. A water literate citizen understands essential principles and concepts about the Great Lakes' functions and value and can accurately communicate about the Great Lakes' influence on people and systems.¹⁶ However, what truly makes a person literate is application of such concepts; making informed and responsible decisions regarding the Great Lakes. A knowledgeable citizenry ensures a system of checks and balances is in place. Understanding the tangible and intangible value of water resources and recognizing that value when making decisions and setting policy is fundamentally important. With demand for water increasing and potential systematic instability as a result of climate change, the connection between water literacy and human use is more essential now than ever before.

¹¹ *About Our Great Lakes: Economy*, 2013, National Oceanic and Atmospheric Admin. (NOAA) - Great Lakes Environmental Research Lab (GLERL),

¹² Vaccaro, L., Read, J., *Vital to Our Nation's Economy: Great Lakes Jobs*, 2011, Michigan Sea Grant, MICHU-11-203.

¹³ *Michigan-Great Lakes Plan: Our Path to Protect, Restore, and Sustain Michigan's Natural Treasures*, 2009, MDEQ.

¹⁴ *About Our Great Lakes: Economy*, NOAA GLERL.

¹⁵ Vaccaro, L., Read, J., *Vital to Our Nation's Economy: Great Lakes Jobs*.

¹⁶ Great Lakes Literacy Principles, greatlakesliteracy.net.

Effective Governance Structures for Water Literacy

No one entity can or should govern all learning. Educational content is delivered through many different mechanisms, including museums, zoos, aquaria, parks, web resources and formal, accredited courses. The key learning audiences include K-16 students and educators, researchers, citizens, businesses, natural resource managers, city planners, and legislators. Federal and state agencies govern formal K-12 education and use testing instruments to measure retention. Federal and state standards help guide curriculum content (e.g., Next Generation Science Standards, and State of Michigan Grade Level Content Standards). It is crucial for everyone to become educated on the importance of water to global and environmental health.

Coursework about water resources is readily available, but unlike other critical areas of knowledge, it generally is not required of all students. Today's learners expect content delivery to be more dynamic and are demanding more hands-on experiences. For example, educators and students are partnering with local government and non-governmental organizations to create more meaningful and lasting connections at all levels of education. These connections become the things students remember as adults, whether they continue in the field of environmental sciences or simply become more educated decision-makers.

Another significant trend is the increased support of water institutes and centers at many universities by public and private donors. These centers support research and education, including dual degree programs (e.g., environment and law, public health, or engineering). Many universities are supporting multi-disciplinary research teams to tackle complex environmental issues. To better address these issues, university faculty, staff and students develop decision support tools and provide certification programs to help ensure high-quality content about water resources is accessible to more people. Businesses and communities often benefit from university partnerships, specifically the work of students to assist with planning.

Sustainable Funding Solutions

Investment in expanding water literacy faces several funding obstacles. The Michigan Water Strategy must be developed in light of limited federal and state financial resources and increasing tuition costs. The Michigan Great Lakes Plan¹⁷ states: "Michigan citizens recognize that it will take a **collaborative investment** of federal, state, and local governments, tribes, nongovernmental organizations, and private funds to realize the full economic and societal benefits that will result from protecting and restoring Michigan's Great Lakes."

Such a "collaborative investment" requires collective visioning and determination of goals, through a democratic, inclusive and participatory process. Similarly, Kania and Kramer discuss "collective impact" as the commitment of a group of important actors from different sectors to a common agenda for solving a specific social problem.¹⁸ To gain trust and develop lasting partnerships in improving water literacy, a variety of stakeholders must be engaged, including citizens, businesses, industries, local governments and universities. Collective impact formalizes collaboration and partnership to "involve a centralized infrastructure, a dedicated staff, and a structured process that leads to a common agenda, shared measurement, continuous communication, and mutually reinforcing activities among all participants."¹⁹

Many foundations and funding agencies prioritize project-based efforts, versus systematic investments, giving preference to short-term, easily measurable outcomes. Sustainable support for education requires a fundamental change to embrace that "social change can come from the gradual improvement of an entire system over time, not just from a single breakthrough by an individual organization."²⁰ Financial support is required to formalize collaborative partnerships, develop metrics and promote long-term community leadership. Existing Great Lakes-related initiatives operate as effective but disparate units making significant contributions to Great Lakes education. Imagine how powerful the collective impact could be through collaborative investment.

¹⁷ *Michigan-Great Lakes Plan: Our Path to Protect, Restore, and Sustain Michigan's Natural Treasures*, 2009, MDEQ.

¹⁸ Kania, J., Kramer, M., *Collective Impact*, Stanford Social Innovation Review, Winter 2011, Stanford University.

¹⁹ *Ibid.*

²⁰ *Ibid.*

Monitoring and Metrics

In order to achieve a greater understanding of water literacy, we must collectively agree on common goals and measurement systems. Communication throughout the process is essential to implementing a shared vision about water literacy. Regular evaluation to determine the efficacy of a common set of objectives and goals is critical to refining approaches based on a specific set of metrics and performance measures. Monitoring and assessment at the K-12 level is driven by both federal and state guidelines.

The primary goal of the Michigan Department of Education is to “continue developing an effective and equitable performance-based system that achieves academic growth and successful outcomes for all students.”²¹ One of the key points outlined in education reform priorities is to improve student achievement through innovation and specifically focus on “improving the academic outcomes of African-American males for whom data show are Michigan’s persistently lowest achieving subgroup.”²²

The *Five E Learning Cycle Model* (Engagement, Exploration, Explanation, Elaboration and Evaluation) provides a structure for engagement, as well as assessment. Educators are using a variety of methods to determine the efficacy of educational content delivered using newer pedagogical methods. Rubrics are a common and powerful tool used to assess student performance using qualitative and quantitative data.²³ They also help facilitate clear communication about performance criteria.

Effectively measuring water literacy among youth and adults requires careful consideration. A multi-disciplinary team of scientists and educators could establish a baseline of water literacy to determine what is known and what should be known. Evaluation criteria might also determine how natural resource managers assess water quality to determine if they are leveraging new tools and technologies. Several example metrics include:

- Inclusive science-based decision making
- Greater understanding of the connection to economic vitality
- Specific evidence of application of tools about water
- Increased engagement in water stewardship activities
- Adaptive management and quality improvement
- Public and private support for research and education
- Support for remediation of contaminated areas

In addition, public involvement and an inclusive process in water resources issues help foster greater engagement and understanding about issues. Regardless of the criteria for metrics, action plans must follow assessment, as well as a commitment to improving processes and procedures to increase water literacy.

²¹ Michigan State Board of Education and Michigan Dept. of Education Goal Reform Priorities, 2012-2013, State of Michigan Dept. of Education.

²² *Ibid.*

²³ Wolf, K., Stevens, E., *The Role of Rubrics in Advancing and Assessing Student Learning*, Journal of Effective Teaching, Vol. 7, No. 1, 2007 3-14.