Great Lakes Literacy Principles

1. The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world ocean.
2. Natural forces formed the Great Lakes; the lakes continue to shape the features of their watershed.
3. The Great Lakes influence local and regional weather and climate.
4. Water made Earth habitable; fresh water sustains life on land.
5. The Great Lakes support a broad diversity of life and ecosystems.
6. The Great Lakes and humans in their watersheds are inextricably interconnected.
7. Much remains to be learned about the Great Lakes.
8. The Great Lakes are socially, economically, and environmentally significant to the region, the nation, and the planet.
GREAT LAKES LITERACY: Essential Principles and Fundamental Concepts for Great Lakes Learning

Each principle is supported by fundamental concepts comparable to those in the Ocean Literacy Principles; consult the Great Lakes Literacy website [www.greatlakesliteracy.net] to view the Principles and their alignment to the National Science Education Standards.

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**1. THE GREAT LAKES, BODIES OF FRESH WATER WITH MANY FEATURES, ARE CONNECTED TO EACH OTHER AND TO THE WORLD OCEAN.**

- **A.** The Great Lakes are a dominantly physical feature of North America and form part of the political boundaries between the United States and Canada.
- **B.** The Great Lakes system includes the Great Lakes (Superior, Huron, Michigan, Erie, and Ontario), Lake St. Clair, and the connecting channels, along with many harbors and bays. Each lake has distinctive basin features, circulation, and ecology.
- **C.** The Great Lakes contain nearly 20% of the world’s fresh surface water and have a coastline longer than the East Coast of the United States. Most of North America’s fresh surface water (95%) is in the Great Lakes.
- **D.** The Great Lakes, their respective watersheds and waterways, and the ocean are all connected. Within the Great Lakes system, water flows from the upper lakes (Lake Superior, Lake Michigan, and Lake Huron) through Lake St. Clair into Lake Erie, over Niagara Falls and into Lake Ontario before flowing through the St. Lawrence River into the ocean. Rivers and streams transport nutrients, dissolved gases, salts and minerals, sediments, and pollutants from watersheds into the Great Lakes.

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**2. NATURAL FORCES FORMED THE GREAT LAKES; THE LAKES CONTINUE TO SHAPE THE FEATURES OF THEIR WATERSHEDS.**

- **A.** Ancient igneous and metamorphic rock formations of the upper Great Lakes basin. Other rocks underlying the present-day Great Lakes and surrounding watershed are sedimentary, originating during a time when shallow tropical seas covered the basin. Many of the rocks now exposed on land were deposited and shaped during bedrock advance and retreat of glaciers.
- **B.** During the Ice Age, mile-thick sheets of ice covered the Great Lakes region multiple times, depressing the crust with their weight. Recent large ice sheets melt and lake levels rise and fall, creating weather and climate changes that affect the composition and distribution of species in the lakes. Since glaciers retreated (about 10,000 years ago), Earth’s crust has been uplifting in a process of isostatic rebound that continues today.
- **C.** Lake-level changes influence the physical features of the Great Lakes. Lake water levels show changes and patterns that vary over periods of hours to millennia.
- **D.** Erosion—the wearing away of rock, soil and other earth materials—occurs in coastal areas as wind, waves, and currents in rivers and the Great Lakes move sediments.
- **E.** Sediments are a product of erosion and consist of fragments of animals, plants, rocks, and minerals. Sediments are classified by grain size, from silt and clay to sand, cobbles, and boulders. Sediments are seasonally redistributed by waves and coastal currents and help maintain beaches and coastal wetlands.

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**3. THE GREAT LAKES INFLUENCE LOCAL AND REGIONAL WEATHER AND CLIMATE.**

- **A.** The Great Lakes affect weather and climate by impacting the basin’s energy and water cycles. Changes in the Great Lakes’ water circulation, water temperatures, and ice cover produce changes in weather patterns.
- **B.** The Great Lakes warm by absorbing solar radiation. Lake temperatures are also affected locally by the temperature of inflowing river water. The Great Lakes lose heat by evaporation and by the warming of overlying air when the atmosphere is cool. Windy upper water moves and helps distribute heat over the water surface, in turn influencing climate and weather conditions. Lake-effect snows result from cold, lake water, and cold winds from the north and west....
- **C.** The Great Lakes modify the local weather and climate. Because water temperatures change more slowly than land temperatures, lake waters gain heat in summer and release heat during cooler months. This results in cooler summers, warmer falls, delayed frosts, and lake-effect snows.
- **D.** The Great Lakes have a significant influence on regional climate by absorbing, storing, and moving heat and water. Lake-effect precipitation can occur downwind when major weather systems move over the lakes.
- **E.** The Great Lakes are influenced by larger climate change patterns affecting North America and the world. Climate patterns in the Great Lakes are changing, with warmer and drier conditions predicted.

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**5. THE GREAT LAKES SUPPORT A BROAD DIVERSITY OF LIFE AND ECOSYSTEMS.**

- **A.** Life in the Great Lakes ranges in size from the smallest blue-green bacteria, such as Microcystis, to the largest animal that still lives in the Great Lakes, lake sturgeon.
- **B.** Most life in the Great Lakes exists as microorganisms. Microorganisms, such as phytoplankton and cyanobacteria, are the most important producers in the lakes.
- **C.** The Great Lakes’ watersheds support organisms from every kingdom on Earth.
- **D.** The Great Lakes biology provides many examples of life cycles, adaptations, and important relationships among organisms, such as symbiosis, predator-prey dynamics, and energy transfer.
- **E.** The Great Lakes ecosystem provides habitat for terrestrial and aquatic species. The Great Lakes are three-dimensional, offering vast living space and diverse habitats from the shoreline and surface down through the water column to the lake floor.

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**6. THE GREAT LAKES AND HUMANS IN THEIR WATERSHEDS ARE INEXTRICABLY INTERCONNECTED.**

- **A.** The Great Lakes affect many human lives. They supply fresh water to more than 40 million people. They are a source of drinking water and food, as well as mineral and energy resources.
- **B.** One-third of the North American population lives in the Great Lakes’ watershed. Some of the most urbanized regions in the United States and Canada can be found around the lakes.
- **C.** The Great Lakes are affected directly by the decisions and actions of people throughout the watershed, which includes parts of the states of Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, New York, and Wisconsin, the Canadian provinces of Ontario and Quebec, and tribal lands.
- **D.** Local and national laws, regulations, and resource management affect what is put into and taken out of the Great Lakes. Shoreline development and industrial or commercial activities lead to point and non-point source pollution. Humans have altered the biology of the lakes and the viability of species through harvesting, species introduction, and nutrient loading.
- **E.** Coastal regions along the Great Lakes are impacted by land-use decisions and natural hazards. Physical modifications (changes to beaches, shores, and river) can exacerbate effects of erosion, storm surges, and lake-level changes.
- **F.** To ensure continued availability of Great Lakes assets, people and ecosystems must live in ways that sustain the lakes. Individual and collective actions are needed to effectively conserve and manage Great Lakes resources for the benefit of all.

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**7. MUCH REMAINS TO BE LEARNED ABOUT THE GREAT LAKES.**

- **A.** Exploration and understanding of Great Lakes interactions and links among diverse ecosystems and peoples are ongoing. Each exploration offers great opportunities for inquiry and investigation.
- **B.** Understanding the Great Lakes is more than a matter of curiosity. Exploration, inquiry, and monitoring promote better understanding and protection of Great Lakes ecosystems, resources, and processes.
- **C.** Over time, use of Great Lakes resources has changed significantly. The future sustainability of Great Lakes resources depends on our understanding of those resources and their potential and limitations.
- **D.** New technologies and methods of observation are expanding our ability to explore the Great Lakes. Fresh water scientists rely on such tools to monitor conditions in the Great Lakes and provide information to policy makers and leaders in coastal communities.
- **E.** Models help us understand the complexity of the Great Lakes. Models process observations, describe interactions among systems, expose information gaps, and forecast change.

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**8. THE GREAT LAKES ARE SOCIALLY, ECONOMICALLY, AND ENVIRONMENTALLY SIGNIFICANT TO THE REGION, THE NATION, AND THE PLANET.**

- **A.** The Great Lakes are a source of inspiration, recreation, rejuvenation, and discovery. They are also an important element in the heritage of many cultures.
- **B.** The waters of the Great Lakes have been significant to historical settlement and development. The lakes’ names and the names of many cities, counties, and landmarks represent Native American or immigrant origins. This fresh water resource will continue to play a role in future habitation of the area.
- **C.** The Great Lakes’ moderating effects on climate influence the human culture, activities, agriculture, and health of adjacent coastal areas.
- **D.** Waterborne commerce moves millions of tons of cargo annually through the Great Lakes. Shipping is an economically efficient method of transporting raw materials, finished goods, and agricultural products. However, shipping also is a vector for non-native species, several of which may be detrimental to the Great Lakes ecosystem.
- **E.** The economy is diverse in the Great Lakes, with major sectors in industry, recreation and tourism, agriculture, commercial and sport fisheries, forestry, and mining.
- **F.** The Great Lakes were dramatically degraded and challenged by human endeavors in recent times. Basic ecosystem processes have been restored through individual and collective efforts. Proper foresight and informed decision-making will continue to make the Great Lakes a model of environmental protection, restoration, and innovation.