

| <p style="text-align: center;"><b>Ocean Literacy</b><br/>Principles</p> | <p style="text-align: center;"><b>Lake Erie Literacy</b><br/>Principles</p>             |
|---|---|
| 1. The Earth has one big ocean with many features.                      | 1. Lake Erie, one of the five Great Lakes, is a body of fresh water with many features. |
| 2. The ocean and life in the ocean shape the features of the Earth.     | 2. Natural forces formed and continue to shape Lake Erie and its watershed.             |
| 3. The ocean is a major influence on weather and climate.               | 3. Lake Erie influences regional weather and climate.                                   |
| 4. The ocean makes Earth habitable.                                     | 4. Water makes Earth habitable; fresh water sustains life.                              |
| 5. The ocean supports a great diversity of life and ecosystems.         | 5. Lake Erie supports a great diversity of life and ecosystems.                         |
| 6. The ocean and humans are inextricably interconnected.                | 6. Lake Erie and humans in its watershed are inextricably interconnected.               |
| 7. The ocean is largely unexplored.                                     | 7. Exploration and understanding of Lake Erie is ongoing.                               |
|   | 8. Lake Erie is socially, economically and environmentally significant.                 |

## From ***Ocean Literacy: Essential Principles and Fundamental Concepts***

Ocean literacy is an understanding of the ocean's influence on you and your influence on the ocean.

An ocean-literate person:

- understands the essential principles and fundamental concepts about the functioning of the ocean;
- can communicate about the ocean in a meaningful way; and
- is able to make informed and responsible decisions regarding the ocean and its resources.

## Lake Erie Literacy Principles and Concepts

**Lake Erie Literacy** is an understanding of Lake Erie's influence on you and your influence on the freshwater lake.

**A Lake Erie literate person:**

- Understands the essential principles and fundamental concepts about the functioning of Lake Erie and its watershed,
- Can communicate about Lake Erie in a meaningful way;
- Acknowledges his or her role within the ecosystem; and
- Is able to make informed and responsible decisions that enhance Lake Erie and its resources.

The Ohio Department of Natural Resources (ODNR) Office of Coastal Management, ODNR Division of Wildlife - Old Woman Creek National Estuarine Research Reserve, the Ohio Sea Grant College Program and the Ohio Lake Erie Commission are developing a unified strategic plan for Lake Erie education and outreach. As part of this effort, the agencies identified a need for a place-based environmental literacy framework for Lake Erie. A project team initiated the development of this framework by adapting Ocean Literacy: The Essential Principles and Fundamental Concepts to Lake Erie.

The Lake Erie Literacy Principles and Concepts are in *DRAFT* form. Input is desired from researchers, educators, non-government organizations and others involved with Lake Erie protection, restoration, research, education and outreach throughout the watershed, including from the United States and Canada.

The International Association for Great Lakes Research Conference (May 2009) served as the formal introduction of the effort to develop Lake Erie Literacy Principles and Concepts. Lake Erie scientists, educators, resource managers and those interested in the resource are invited to provide their input and recommendations. Feedback on the Principles and Concepts is also being accepted on the website: [ohiodnr.com/LakeErieLiteracy](http://ohiodnr.com/LakeErieLiteracy).

For more information or to provide feedback, you may also contact Lake Erie Literacy project team members:

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[ohiodnr.com/LakeErieLiteracy](http://ohiodnr.com/LakeErieLiteracy)

# 1. Lake Erie, one of the five Great Lakes, is a body of fresh water with many features.

- a** Lake Erie, as part of the Great Lakes, is a dominant physical feature of the Midwestern United States and is a boundary water located between the United States and Canada.
- b** Lake Erie is the shallowest, warmest, most southern of the Great Lakes. Lake Erie's shore length is 871 miles (including approximately 40 islands). Although the smallest Great Lake by volume, Erie contains approximately 127.7 trillion gallons of fresh water.
- c** Lake Erie contains three distinct lake basins, the Western, the Central and the Eastern, along with many harbors, bays and embayments. Each lake basin's size, shape and features vary as a result of the glacial carving of the bed of Lake Erie.
- d** Throughout Lake Erie there is an interconnected circulation system powered by wind, waves, the Sun, and water density differences. The shape of Lake Erie's lakebed, its shore and the human-made structures along the shore influence the path of circulation.
- e** Lake level is the height of Lake Erie relative to the sea level as measured on the International Great Lake Datum of 1985. Lake level changes can be caused by wind, waves, the amount of water entering Lake Erie from the upper Great Lakes, evaporation and precipitation rates, ice cover and snow melt. While the same forces are at work on lakes as on oceans, lunar tides typically are not measurable in the Great Lakes.
- f** Lake Erie is an integral part of the Midwestern United States' water cycle and is connected to the region's water reservoirs via evaporation and precipitation processes.
- g** Lake Erie is connected to the Great Lakes, watersheds and waterways and the ocean. All of the upper Great Lakes drain down the Detroit River into Lake Erie. Lake Erie flows over the Niagara Falls eventually reaching Lake Ontario before exiting the St. Lawrence River into the ocean. Rivers and streams (lake tributaries) transport nutrients, salts, sediments and pollutants from watersheds to estuaries and Lake Erie.
- h** Although Lake Erie is large, it is finite and resources are limited.
- i** In summer, Lake Erie stratifies, or forms distinct layers based on water temperature. The warmer surface water known as the epilimnion is lighter and "floats" on top of the cold bottom layer or hypolimnion. The line of rapid temperature change between these two layers is called the thermocline.
- j** Lake Erie's southwest to northeast orientation parallels the prevailing winds and its shallowness makes it especially prone to seiches or wind tides.

## 2. Natural forces formed and continue to shape Lake Erie and its watershed.

**a** Many of the rocks underlying the present day Lake Erie and the surrounding watershed originated during the time when salt water covered the basin. Evidence of the ocean is found in the siliceous and carbonate rocks which now form the Lake Erie basins and lie deep below the surface of the lakebed in limestone and salt deposits. Many of the rocks now exposed on land were carved, deposited, and/or shaped during the advance and retreat of glaciers that followed.

**b** During the glaciations, mile-thick sheets of ice covered the Lake Erie region compressed the earth. After glaciers retreated, the earth's crust adjusted upward in a process termed isostatic rebound. Isostatic rebound was greatest at the eastern edge of Lake Erie, where it drains into Lake Ontario. This caused Lake Erie water levels to rise, creating embayments and drowning river mouths to form estuaries.

**c** Lake level changes, wave action and human development influence the physical structure and landforms of the coast. Lake levels recorded during the last 150 years show daily, seasonal, yearly and multi-year level changes and patterns.

**d** Erosion—the wearing away of rock, soil and other earth materials—occurs in coastal areas as wind, waves, and currents in rivers and Lake Erie move sediments.

**e** Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand on Lake Erie's beaches is eroded from the lake's coast. Sand is eroded from the shore by wave action, surface water and ground water. In Lake Erie, the past 20 years have brought a new source of sand in the form of shell fragments from the invasive mussels. Seasonal sand redistribution by waves and coastal currents can change the shape of the shore.

### 3. Lake Erie influences regional weather and climate.

- a** Lake Erie affects weather and climate by impacting the region's energy, water and carbon systems. Changes in Lake Erie's circulation, water temperatures and ice cover can produce changes in local weather patterns.
- b** Lake Erie absorbs solar radiation reaching Earth. Lake Erie loses heat by evaporation. This heat loss drives atmospheric circulation. After water vapor is released into the atmosphere, it condenses and forms rain. Condensation of water evaporated from warm lake waters provides the energy for storms.
- c** Lake Erie's moderating effects on the climate support regional specialization in viticulture, nurseries, maple sugaring and other agricultural activities.
- d** Precipitation that falls on land can be traced to water that has evaporated from Lake Erie. In the winter, regional snow belts along Lake Erie's US coast extend from Cleveland, Ohio through Buffalo, New York.
- e** Lake Erie plays a role in the Earth's carbon cycle. The sunlit layers of Lake Erie are extremely productive and Lake Erie absorbs carbon dioxide added to the atmosphere.
- f** Lake Erie has and will continue to have, a significant influence on regional climate by absorbing, storing, and moving heat, carbon and water. Lake Erie will also be affected by larger climate change patterns affecting Earth.

## 4. Water makes Earth habitable; fresh water sustains life.

**a** Fresh water has unique properties: its freezing point is slightly higher, its density is slightly lower, and its electrical conductivity is much lower than that of saltwater. Most importantly, freshwater is easily potable.

**b** Most of the United States' fresh surface water (95%) is in the Great Lakes. The Great Lakes contain 18 percent of the world's fresh surface water supply. Approximately 2 percent of the fresh surface water found on Earth is found in Lake Erie. By comparison, all of the fresh surface water rivers on earth also contain 2 percent.

## 5. Lake Erie supports a great diversity of life and ecosystems.

- a** Life in Lake Erie ranges in size from the smallest virus to the largest animal that still lives in fresh water, lake sturgeon.
- b** Lake Erie is the most biologically productive Great Lake. Most life in Lake Erie exists as microorganisms. Microorganisms such as phytoplankton and bacteria are the most important primary producers in Lake Erie. Microbes are the most abundant life form in Lake Erie and they have extremely fast growth rates and short life cycles.
- c** Excluding echinoderms, the major taxonomic groups or organisms found in the ocean are also represented in Lake Erie.
- d** Lake Erie biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer).
- e** Lake Erie is three-dimensional, offering vast living space and diverse habitats from the surface down through the water column to the lake floor.
- f** Lake Erie habitats are defined by environmental factors. As a result of interactions of abiotic factors such as temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, life in Lake Erie is not evenly distributed temporally or spatially. Some regions of Lake Erie support more diverse and abundant life, while in other areas organisms are patchy. Abiotic factors within Lake Erie can change daily, seasonally or yearly because of environmental factors and human influences.
- g** Ecosystem processes and predation cause vertical zonation patterns influencing the distribution and diversity of organisms.
- h** Fresh water wetlands, including coastal marshes and estuaries, provide important and productive nursery areas for many aquatic and terrestrial species which rely on these habitats for hunting grounds, migration stops, and raising offspring.
- i** The Lake Erie ecosystem provides habitat for unique species both on land and in the water. Some endemic species such as the Lake Erie water snake, or threatened species like the Lakeside Daisy, thrive in the Lake Erie ecosystem.
- j** Life cycles in Lake Erie have been altered by invasive plant and animal species.

## 6. Lake Erie and humans in its watershed are inextricably interconnected.

- a** Lake Erie affects many human lives. It supplies freshwater to more than 11 million people. It moderates the climate within adjoining coastal land areas, impacting and influencing the weather, culture and human health.
- b** Lake Erie is a source of food, as well as mineral and energy resources. It provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
- c** One third of the Great Lakes population lives in Lake Erie's 30,140 square-mile watershed. Lake Erie's watershed is the most urbanized of all the Great Lakes. It also has the highest population density and is the most intensively farmed.
- d** Humans affect Lake Erie in a variety of ways. Laws, regulations and resource management affect what is taken out of and put into Lake Erie. Human development and industrial/commercial activities lead to pollution and physical modifications (changes to beaches, shores and rivers). Humans have also physically modified the coast and watershed. This has altered littoral processes, the biology of the lake and the viability of fish, mollusk and invertebrate species.
- e** Coastal regions along Lake Erie are susceptible to natural hazards (erosion, storm surges, short-term and long-term lake level changes, and floods).
- f** Lake Erie sustains life. Everyone who lives in, visits or uses products, goods or services created in the Lake Erie watershed benefits from and shares a role in caring for Lake Erie. To maintain these uses, people must live in ways that sustain the lake. Individual and collective actions are needed to effectively manage Lake Erie resources for the benefit of all.
- g** Lake Erie is affected by the decisions and actions of people throughout its watershed which includes parts of the states of Michigan, Ohio, Pennsylvania, and New York, and the Canadian province of Ontario. Lake Erie is also impacted by the decisions of people living in the watersheds of the upper Great Lakes because water from these lakes flows to Lake Erie.

## 7. Exploration and understanding of Lake Erie is ongoing.

- a** The interactions and links between Lake Erie's diverse ecosystems and their societal connections are a frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.
- b** Understanding Lake Erie is more than a matter of curiosity. Exploration, inquiry and study are required to better understand, protect and conserve Lake Erie ecosystems and processes.
- c** Since about 1970, use of Lake Erie resources has changed significantly, therefore the future sustainability of Lake Erie resources depends on our understanding of those resources and their potential and limitations.
- d** New technologies, sensors and tools are expanding our ability to explore Lake Erie. Freshwater scientists now rely on satellites, drifters, buoys, sidescan sonar, under water observatories and remotely operated submersibles to monitor conditions in Lake Erie over time and provide information to policy-makers and leaders in coastal communities.
- e** Use of mathematical ecosystem models is now an essential part of Lake Erie sciences. Models help us understand the complexity of Lake Erie and of its interaction with the Great Lakes and Earth's climate. These models process observations, describe interactions, expose information gaps and forecast change.
- f** Exploration and understanding of the Lake Erie ecosystem is interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, physicists, social scientists, educators, and communications specialists.

## 8. Lake Erie is socially, economically and environmentally significant.

- a** Lake Erie is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures.
- b** The waters of Lake Erie have been key to historical settlement and development. The lake's name and the names of many counties and communities along its shore have Native American origins. The fresh water resource will continue to play a role in future habitation of the area.
- c** Lake Erie and its access to the world lured a convergence of nationalities that is reflected today in ethnic contributions to art, music, religion, architecture, food, agricultural and others aspects of life.
- d** Lake Erie has been a key element in the formation of the United States from the writing of the Northwest Ordinance, to the Battle of Lake Erie during the War of 1812, to providing an escape to freedom as a key link in the Underground Railroad.
- e** Waterborne commerce moves approximately one million tons of cargo annually among Lake Erie. Shipping is an economically efficient method and more environmentally sound method of transporting raw materials (iron ore, salt, limestone, coal and grain), finished goods, and agricultural products.
- f** Lake Erie communities have economically benefited from visitors to the lake for more than a century. People travel to the region each year to fish, boat, camp, swim, sail, and view wildlife. They also visit lighthouses, historic monuments, vineyards, amusement parks, state or city parks, and marinas.
- g** Lake Erie is one of the largest and most successful restoration projects in the world. Pollution that nearly destroyed the lake resulted in benefits to water resources throughout the country with the formation of the U.S. Environmental Protection Agency and the passage of legislation such as the Clean Water Act and Coastal Zone Management Act. Today Lake Erie is used as a representative model for environmental management.
- h** With proper foresight and informed decision making, Lake Erie can continue to be a bellwether for environmental protection, restoration and innovation.