GREAT LAKES AND CLIMATE EDUCATION RESOURCES
WHO ARE WE?

Lyndsey Manzo
Ohio Sea Grant Educator
High School Science Teacher
manzol@wcsoh.org

Christina Dierkes
Ohio Sea Grant
Outreach Specialist
dierkes.10@osu.edu
AGENDA

Ocean Literacy Principles

Great Lakes Literacy Principles

Climate Literacy Principles

Climate Change Outreach Team’s Webinars

Great Lakes Climate Change Curriculum
THE GREAT GREAT LAKES!

- 16,000 km shoreline
- 20% of world’s fresh surface water
- 85 million people [1/4 of U.S. population]
- 13 million K-12 students
- 2 countries, 8 states, 2 provinces, 19 tribes
THE GREAT GREAT LAKES!

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OCEAN LITERACY: The Essential Principles of Ocean Sciences

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of the Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The oceans and humans are inextricably interconnected.
7. The ocean is largely unexplored.
CLIMATE LITERACY PRINCIPLES

CLIMATE LITERACY: The Essential Principles of Climate Science

1. The Sun is the primary source of energy for Earth’s climate system.
2. Climate is regulated by complex interactions among components of the Earth system.
3. Life on Earth depends on, is shaped by, and affects climate.
4. Climate varies over space and time through both natural and man-made processes.
5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling.
6. Human activities are impacting the climate system.
7. Climate change will have consequences for the Earth system and human lives.
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 makes 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.
Great Lakes
Literacy Principles

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8. The Great Lakes are socially, economically, and environmentally significant to the region, the nation and the planet.

For more information or a copy of the Literacy Principles Brochure, visit greatlakesliteracy.net
PRINCIPLES & FUNDAMENTAL CONCEPTS

PRINCIPLES

1. The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world ocean.

2. The Great Lakes system includes five Great Lakes (Superior, Michigan, Huron, Erie, and Ontario), Lake St. Clair, and the connecting channels, along with many harbors and bays. Each lake has distinctive bath features, circulation, and hydrology.

3. The Great Lakes contain nearly 20 percent of the world's fresh surface water and have a coastline longer than the coast of the United States. Most of North America's fresh surface water (95%) is in the Great Lakes.

4. The Great Lakes, their respective watersheds and waterways, and the oceans, are all connected. Within the Great Lakes system, water flows from Lake Superior and Lake Michigan to 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 oceans. Rivers and streams transport nutrients, dissolved gases, salts and minerals, sediments, and pollutants from waterways into the Great Lakes.

5. The Great Lakes are an integral part of the water cycle and are connected to the region's watersheds and water systems. Changes in water systems affect the quality, quantity, and movement of water, including retention time.

6. Water currents circulate within the Great Lakes and are powered by wind, varied, energy from the sun and water density differences. The shape of a lake and its atmospheric circulation, the direction of the prevailing winds, the shores and the structures along the shorelines influence the path of circulation. Circulation between the lakes is driven by gravity.

7. Lake levels are the height of the Great Lakes relative to sea level. Lake level changes are caused by variations in precipitation, evaporation, runoff, and snow melt, as well as wind and climate. Freshwater lakes are typically not observable in the Great Lakes, as they are common in the lakes.

8. The Great Lakes are dry in the summer and in winter under the snow, forming distinct layers based on water temperature differences. Turnover occurs in the spring and fall when cooler water temperatures mix temperature differences and the layers mix. Turnover is the main way that oxygen and nutrient-rich water in the deeper areas of the lakes can be mixed with oxygen and nutrient-rich surface water.

9. Although the Great Lakes are large, they are finite and their resources are limited.
**RESOURCE PAGE**

**GREAT LAKES LITERACY**

**GREAT LAKES LITERACY PRINCIPLES**

Great Lakes literacy is an understanding of the Great Lakes' influences on you and your influence on the Great Lakes.

**PRINCIPLE 3**

**Lessons and Activities**

- **Fresh and Salt Activities**
  - How is Great Lakes Temperature Influenced by the Great Lakes and the Ocean? (Size: 5 KB) Grade 5-6
  - Implications of Warming the Arctic (Size: 2 KB) Grade 5-12

- **Greatness of the Great Lakes**
  - What Happens to Heat Energy Reaching the Great Lakes? How Do the Great Lakes Affect Temperature? (Size: 260 KB) Grade 7-8
  - Is the Climate Changing? Is There Evidence in the Great Lakes Region? (Size: 309 KB) Grade 7-8
  - How Do the Great Lakes Modify the Growing Season? (Size: 6 KB) Grade 5-10

- **Screenwriting - Great Lakes Style**
  - How Does the Temperature of the Great Lakes Change Over Time? (Size: 1 KB) Grade 5-10

- **Other Related Lessons**
  - What Factors Increase Ice Coverage on the Great Lakes? (Size: 61 KB) Grade 5-12
  - Effects of Lakes Climate Change on Ecosystems (Size: 35 KB) Grade 5-12
  - What Great Lakes factors will increase or decrease as a result of global warming? (Size: 36 KB) Grade 5-12

**Other Resources**

- **Related Websites**
  - Great Lakes Information Network (GLIN)
  - Great Lakes Coastal Forecasting System, NOAA, GLIN
  - Great Lakes Map, NOAA's National Weather Service

- **Data Sets**
  - Great Lakes Data Buoy Center (West)
  - Great Lakes Data Buoy Center (East)

**Additional support for implementation:**

- Lessons
- Content
- Links
- Datasets
- Tools
LESSONS

COSEE Great Lakes Curricula

Other Related Lessons

- Should chlorine be banned from the Great Lakes?
  (Size: 59 KB)
- Who owns the water of the Great Lakes?

Fresh and Salt Activities

- How is Coastal Temperature Influenced by the Great Lakes and the Ocean?
  (Size: 5 MB) Grade 6-8
- Implications of Warming in the Arctic
  (Size: 2 MB) Grade 6-12

Greatest of the Great Lakes

- What Happens to Heat Energy Reaching the Great Lakes? How Do the Great Lakes Affect Temperature?
  (Size: 269 KB) Grade 7-8
- Is the Globe Warming? Is There Evidence in the Great Lakes Region?
  (Size: 309 KB) Grade 7-8
- How Do the Great Lakes Modify the Growing Season?
  (Size: 4 MB) Grade 9-10
- Snowmaking - Great Lakes Style
  (Size: 1 MB) Grade 9-10
GLLP SPECIFIC RESOURCES

Online Presentations

- Bedrock and Formation of the Great Lakes
- Life in Rocks – Fossils
- Lake Levels and Coastal Erosion
- Great Lakes Geology – The Human Connection
- Geologic Processes

* Online presentations are available as part of the College of Exploration, a web-based, global learning network. You will be asked to register with the community which is a free, safe and simple process.

Related Websites

- Glacier Animation
- Changing Climate
- Weather and Climate of the Great Lakes Region, Great Lakes Information Network (GLIN)
- Climate Change of the Great Lakes Region, Great Lakes Information Network (GLIN)
- Climate in the Great Lakes Region: The Challenge; The Impacts; The Solutions. Union of Concerned Scientists
GLLP SPECIFIC RESOURCES

Data Sets

- Weather Buoy Data for the Great Lakes, NOAA/GLERL/CoastWatch Great Lakes Node
- National Data Buoy Center (West)
- National Data Buoy Center (East)
- Great Lakes Coastal Forecasting System, NOAA, GLERL
- Great Lakes Maps, NOAA’s National Weather Service
- Christmas Climate Data for Ohio

Miscellaneous Resources

- Ice Cover on the Great Lakes (fact sheet)
- Climate Change in the Great Lakes Region: Starting a Public Discussion (brochure)
- Impacts of Climate Change on Our Region’s Water (fact sheet)
- Great Lakes Storms Photo Gallery
OTHER RESOURCES

- NSES Alignment
- Great Lakes Agency Links
- More Great Lakes Curricula
- General Great Lakes Data

Sea Grant Offices
- Illinois-Indiana Sea Grant
- Michigan Sea Grant
- Minnesota Sea Grant
- New York Sea Grant
- Ohio Sea Grant
- Pennsylvania
- Wisconsin

NOAA Great Lakes Environmental Research Laboratory (GLERL)
http://www.glerl.noaa.gov/gll/ourlakes/
This site contains useful information on the Great Lakes including facts, ecology, threats and lake profiles. It also contains information on educational programs, community programs and career information.

Great Lakes Information Network (GLIN)
http://great-lakes.net/
This is an excellent website for online information relating to the binational Great Lakes region. The site includes TEACH Great Lakes that features mini-lessons on many Great Lakes topics such as the environment, history and culture, geography and careers.

US EPA Great Lakes National Program Office (GLNPO)
http://epa.gov/greatlakes/index.html
An excellent source of Great Lakes environmental information including short descriptions of each of the Great Lakes, physical facts about the lakes and a link to the Environmental Atlas and Resource Book.

Alliance for the Great Lakes
http://greatestates.org
OTHER RESOURCES

NSES Alignment

Great Lakes Agency Links

More Great Lakes Curricula

General Great Lakes Data

Teaching with Great Lakes Data
http://www.greatlakeslessons.com/

Project Flow
http://www.miseagrant.umich.edu/flow/

Digital Great Lakes
http://seagrant.wisc.edu/digitalgreatlakes/

Regional Gateway for the Great Lakes (Bridge for Marine Education)
http://web.vms.edu/bridge/greatlakes.html?svr=www

Lake Superior Streams
http://www.lakesuperiorstreams.org/

Earth Systems - Education Activities for Great Lakes Schools
http://earthsys.ag.ohio-state.edu/project/pubs/ES_EAGLS.html

Supplemental Curriculum Activities to accompany Holling Clancy Holling’s Paddle-to-the-Sea
http://earthsys.ag.ohio-state.edu/project/pubs/Paddle.html

Great Lakes in My World
http://www.greatlakes.org/greatlakesinmyworld

Water on the Web
http://www.waterontheweb.org/curricula/wa/unit_01/index.html
OTHER RESOURCES & LINKS

OTHER RESOURCES

- NSES Alignment
- Great Lakes Agency Links
- More Great Lakes Curricula
- General Great Lakes Data

GENERAL GREAT LAKES DATA

Teaching with Great Lakes Data
http://www.greatlakeslessons.com/

NOAA CoastWatch
http://coastwatch.glerl.noaa.gov/
This site includes data as well as satellite imagery.

Great Lakes Observing System (GLOS)
http://glos.us/

Great Lakes Atlas
http://www.epa.gov/greatlakes/atlas/

NOAA – National Weather Service (Great Lakes Region)
http://www.crh.noaa.gov/greatlakes/

NOAA-GLERL Data Center
http://www.glerl.noaa.gov/data/
OTHER RESOURCES & LINKS

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HELPFUL LINKS

- Ocean Literacy Principles
- Lake Erie Literacy Principles
- Climate Literacy Principles
- Earth Science Literacy Principles
- National Marine Educators Association
- Great Lakes Educators of Aquatic and Marine Science
Climate Change in the Great Lakes

Frequency of Heavy Precipitation Events in the Great Lakes Region

(a) 24-Hour Events

(b) 7-Day Events
Climate Change Outreach Team

changingclimate.osu.edu
Climate Change and Water Quality in the Great Lakes
Tuesday, December 7, 2010

GLLP 3E/6A and CLP 7B
Managing Great Lakes Forests for Climate Change Mitigation
Tuesday, January 11, 2011

GLLP 3E/8C and CLP 6C/7E
Economic Implications of Climate Change Impacts to Great Lakes Ports

GLLP 3E/8D and CLP 7A
Climate Change Impacts on Great Lakes Fishes

Tuesday, April 19, 2011

GLLP 3E/5C/5E and CLP 3C
Climate Change Impacts on Great Lakes Water Levels

Tuesday, May 10, 2011

GLLP 1G/3E and CLP 7A/7B
CURRICULUM BACKGROUND

- 1995: GLIMCES published by OSG
- > 15 years . . . updates:
  - Climate science
  - Pedagogy
  - Data sets
  - Technology
  - User-friendly (teachers and students)
- Updating ~ 15 lessons
changingclimate.osu.edu
Beyond Polar Bears: Teaching Great Lakes Climate Science

- Tuesday, August 7, 9am to 4pm
- UT Lake Erie Center, Oregon, Ohio

Learn about activities for teaching regionally relevant climate science in your classroom, work through hands-on lessons with fellow educators, and get suggestions on how to adapt classroom activities to informal and outdoor education settings.

These free workshops are taught by educators who have used the resources in their own classrooms. We’ll cover Ohio Sea Grant’s updated Great Lakes climate curriculum, along with climate and Great Lakes literacy principles, and informal resources like OSU’s Global Change, Local Impact webinar series.

If you can’t attend in person, Ohio Sea Grant will also offer a shorter introductory webinar in the fall.

Please email Christina Dierkes to request a registration form for the one-day workshops, or with any questions you have about the events.

Introduction to Great Lakes Climate Education Resources

- Friday, October 19, 10am to 12pm ET
- Online Event

An introduction to the new curriculum, including tips for adapting lessons to your unique educational needs. Attendees will also have the opportunity to ask questions at the end of the presentation.

Sign Up to Attend this Free Webinar

Topics

- Ecosystems
- Public Health
- Infrastructure
- Water
- Climate
- Public Policy
- Education

Great Lakes Curriculum

- Cars on Trial
  (1 MB, Updated: Jun 25, 2012)
- How Will Climate Change Affect a Great Lakes State
  (566 KB, Updated: Jun 25, 2012)
- Google Earth Tour
  (6 KB, Updated: Jun 25, 2012)
- Trees on the Move
  (2 MB, Updated: Jun 25, 2012)
CURRICULUM LOCATION

greatlakesliteracy.net
UPDATED LESSONS

- Visualizing Changes (2 lessons)
- Global and Great Lakes Climate Change
- Greenhouse Gases
- Climate Change and Aquatic Invasive Species
- Climate Change and Estuaries (2, almost 4 lessons)
- Trees on the Move (4 lessons)
- Climate Change Affecting a Great Lakes State
- Cars on Trial
UPCOMING LESSON TOPICS

- Changes in fish habitat (spawning and nursery grounds)
- Water levels
- Ice cover
- Human health
- Interpreting pollen data
- Interpreting ice core data
- Allocating water resources
LESSON FRAMEWORK

- Teacher component
- Student component
- Ready to go as possible
- All reproducible parts are attached
LESSON FRAMEWORK

Background Information
Objectives
Materials/Time Required
Alignment
Lesson – 5 Es: Engage, Explore, Explain, Extend, Evaluate
Additional Resources
References
LESSON FRAMEWORK

Background Information
Objectives
Materials/Time Required
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Lesson – 5 Es: Engage, Explore, Explain, Extend, Evaluate
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VISUALIZING CHANGES

- Lesson 1: construction of a concept map
  - “More or Less”
  - Good for pre/post assessment
  - Whole group or small groups
- Lesson 2: writing about changes between generations
  - Formal or informal audience
  - MS or HS level
  - Easily adapted for other topics
Graphing

Students graph short intervals of temperature anomaly data, then combine graphs to look at long-term data

Trend vs. variation

Technology component

Formal audience

HS level
GREENHOUSE GASES

- Inquiry lab
- Students analyze temperature changes in simulated atmospheres of air, CO$_2$ and H$_2$O vapor
- Materials intensive
- Formal audience
- HS level
GREENHOUSE GASES
CLIMATE CHANGE & AQUATIC INVASIVES

- Jigsaw + authentic assessment
- Students use online or printed fact sheets to become experts on 8 ANS
- They form new groups where they use their expertise to match ANS’ origins, descriptions, ecosystem impacts and population changes due to CC
- Formal or informal audience
- Upper MS/HS level
CLIMATE CHANGE & AQUATIC INVASIVES

ANS Expert Groups

White Perch
Asian Carp

Watermilfoil
Spiny Waterflea

Round Goby
Quagga Mussel

Purple Loosestrife
Sea Lamprey

Card Matching Groups
CLIMATE CHANGE & ESTUARIES

- 2-4 lessons
  - Ecological role of an estuary
  - Estuary impacts on nutrients
  - Role of estuaries as nurseries
  - Wetland migration

- Data/bathymetric map analysis/sampling methods

- Formal audience

- HS level
TREES ON THE MOVE

- 4 lessons
  - Climate model analysis
  - Tree migration simulation (outside)
  - Temperature and seed germination
  - Changes in maple populations (outside)
- Formal audience
- HS level
CLIMATE CHANGE IN A GL STATE

- Google Earth
- Students study 14 aspects of climate change by “flying” in to read about climate events or likely impacts → answer questions
- Write around
- Formal audience
- HS level
- Easily adapted to other states
CARS ON TRIAL

- Role Play
- Students research roles then hold a trial to analyze the role of cars contributing to atmospheric CO$_2$
- 2+ class periods; time for role research
- Formal audience
- HS level
QUESTIONS?
FOLLOW UP

- Watch for an email with a follow up survey
- Provide Ohio Sea Grant with your name and email/address for a certificate of completion
ACKNOWLEDGEMENTS